



Pressures Measured Under Earmuffs Worn by Human Volunteers During Exposure to Freefield Blast Overpressures

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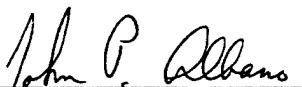
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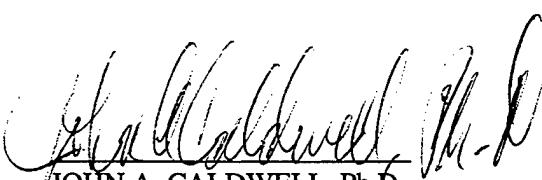
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Introduction

Between 1989 and 1995, the U.S. Army Medical Research and Materiel Command (MRMC) sponsored a series of studies to determine the maximum safe exposures to blast overpressure (high intensity impulse noise). These studies were conducted at the Blast Overpressure Test Site, Kirtland Air Force Base, NM, under contract DAMD-17-88-C-8141 with EG&G, Management Systems Inc, Albuquerque, NM. The studies focused on temporary changes in the threshold of hearing as an indicator of auditory hazard. The temporary threshold shift (TTS) results of these studies have been presented elsewhere (Johnson, 1994; Johnson and Patterson, 1992; Patterson and Johnson, 1994a&b, 1993, 1991, and 1990; Patterson, Mozo, and Johnson, 1993; Patterson, 1991b). From these results, maximum safe exposure levels have been derived in terms of the parameters of the freefield blast signatures (Patterson and Johnson, 1996). In all of the studies, the volunteers wore earmuffs for hearing protection. In collaboration with the contractor researchers at the test site, a field measurement team from the U.S. Army Aeromedical Research Laboratory (USAARL), Fort Rucker, Alabama, recorded the pressure signatures under the earmuffs of a subset of the volunteers participating in the contract studies. These pressure signatures are representative of the effective exposure stimuli arriving at the ears of the volunteers. This report presents the results of these under-the-muff measurements.

Methods

The volunteers for these studies were U.S. Army personnel with less than 5 years active duty. Measurements were made under the earmuffs of three different groups of six volunteers each during exposures to high intensity freefield impulse noise.

All exposure stimuli were produced by the detonation of explosive material, either Composition C-4 or detonating cord. Each group was exposed to a different pressure signature as measured outside the earmuffs. These different signatures were achieved by varying the proximity of the volunteers to the explosive detonation. There were three freefield conditions with volunteer-to-detonation distances of 1 meter, 3 meters, and 5 meters. For each signature, seven explosive charge weights were used to produce seven intensity levels which differed by approximately 3 dB. The number of impulses in an exposure also was varied including 6, 12, 25, 50, and 100 (approximately 3 dB steps on an energy basis).

The earmuffs were compatible with the standard infantry helmet. In addition to the earmuffs, volunteers wore the standard issue infantry helmet and protective goggles during all exposures. Figure 1 shows a typical volunteer as equipped during the exposures. The left earcup and seal were used without modification. Volunteers also used a foam earplug in the left ear as added protection. For the 1-meter and the 3-meter exposure distances, the right ear seal was modified by inserting eight plastic tubes (2.3 mm inside diameter) through the ear seal to produce a leak typical of a bad fitting ear seal. For the 5-meter distance, the right earmuff was unmodified. The attenuation characteristic for the intact and the modified muffs are shown in figure 2. Volunteers

were positioned with the right side of the head oriented toward the explosive source. Figure 3 shows a typical volunteer during an exposure.

Each volunteer was instrumented with a 2 mm diameter piezoresistive pressure transducer (Endevco model 8507-2*) taped to the side of his head with the sensing surface near the entrance to the ear canal. Figure 4 shows a typical volunteer with gauge in position before the muffs were placed over the ears. A gauge was affixed to both sides of the head so the pressure under both the left and right earcup were measured at the same time. The gauge output was amplified and lowpass filtered at 40 kHz using a KEMO model VBF40* (response: -80dB at 1.5 f_c). The pressure-time signatures were digitized by transient data recorders (TDRs) (Pacific Instruments model 9820*) set to a sampling rate of 125,000 samples per second. The resulting digital records were transferred to a personal computer (PC) and stored on disk. Each digital record consisted of 2¹⁵ data points. Data were recorded from each ear canal of three volunteers and from two freefield gauges (PCB model 113B51*) positioned to measure the same signature as would occur at the volunteers' positions without the volunteers. Data transfer rates from TDR to PC precluded the recording of every impulse in an exposure series. Therefore, recordings were made on alternate impulses. Most of the data were recorded during six impulse exposure sequences. This resulted in three records per subject per exposure condition. In a few cases, recordings were made from longer exposure sequences, resulting in a larger number of records for those volunteers on that exposure condition. Some data records were lost due to equipment malfunctions. Post recording, a review of the data was made in an effort to eliminate records with obvious recording artifacts. As a result, some exposure conditions have fewer than three records per volunteer.

All data records were analyzed to determine the peak pressure (kPa), B-duration (ms), A-duration (ms), A-impulse (kPa·ms), total energy (Joules/m²), A-weighted energy (Joules/m²), and P-weighted energy (Joules/m²). The peak pressures were converted to dB to give the peak pressure levels in dB sound pressure level (SPL). The peak pressure levels and B-duration were used to calculate the allowable number of rounds (ANR) according to formulas in military standard (MIL-STD)-1474C. The energy measures were converted to sound exposure levels (SELs) to produce the weighted SEL values for one impulse. Appendix A contains equations that were used in some of the analyses. From these measures, average and standard deviation values were calculated for each freefield exposure condition by averaging the two freefield gauge recordings across all records from the same exposure distance and charge weight. The data from the gauges under the muffs were averaged and the standard deviations calculated for each ear of each subject for each exposure condition. These provided insight into the average values for each volunteer and the variability within individual volunteers across the sequence of impulses. The individual averages were then used to calculate an average and standard deviation for the group. This provided an indication of the overall average and the variability between volunteers.

* See list of manufacturers.

Results and discussion

The results of these studies are summarized in tables containing the descriptive statistics, average and standard deviation, of the various measures¹. In addition, typical pressure-time signatures from a freefield gauge and the right and left earcups from the same blast are included in each appendix. The linear parameters are presented in a table followed by a table containing the levels in dB.

The freefield results from the 1-meter exposure distance (measured outside the muffs) are in appendix B, tables B-1 and B-2. Tables B-3 and B-4 contain the group results from under the muffs at the 1-meter distance. Tables B-5 through B-11 show the individual linear measures for the 1-meter distance, and tables B-12 through B-18 show the individual averages in dB for this distance.

The freefield results from the 3-meter exposure distance are in appendix C, tables C-1 and C-2. Tables C-3 and C-4 contain the group results from under the muffs at the 3-meter distance. Tables C-5 through C-11 show the individual linear measures for the 3-meter distance, and tables C-12 through C-18 show the individual averages in dB for this distance.

The freefield results from the 5-meter exposure distance are in appendix D, tables D-1 and D-2. Tables D-3 and D-4 contain the group results from under the muffs at the 5-meter distance. Tables D-5 through D-11 show the individual linear measures for the 5-meter distance, and tables D-12 through D-18 show the individual averages in dB for this distance.

There are a number of generalizations which apply to the data from all three distances. First, the peak levels and SEL measures show the expected increase of approximately 3 dB per step in the measurements made outside the muffs. The ANR from MIL-STD-1474C shows a decrease from exposures which would be considered acceptable ($ANR > 5$) to exposures which would be rated unacceptable using the limits in MIL-STD-1474C. These are all a result of the study design. In the data from under the muffs, the ANR is quite large at the lowest levels and remains greater than 5 for all conditions. This is an unusual use of the MIL-STD-1474C since it assumes the use of hearing protection and these data were measured under hearing protection (an unprotected exposure). The ANR were "corrected" for the fact that the data come from under the muff, removing the allowance for protection included in the MIL-STD-1474C. (Note, this is equivalent to applying the CHABA, 1968 criterion, which was intended for use with unprotected ears, to the under-the-muff measurements.) The corrected ANRs are not tabled because the values are essentially 0 for all exposure levels for all distances. This is an indication that conventional exposure criteria would predict that all of the exposures used in these studies

¹ A CD containing the raw pressure time histories for all the data discussed here can be requested from the Commander, U.S. Army Aeromedical Research Laboratory, P.O. Box 620577, Fort Rucker, AL 36362. Any request should state the intended use of the data and the benefits to be derived from its use.

should have produced significant TTS. Finally, there are significant individual differences in the levels under the muffs. This can be seen in the group standard deviations which exceed the freefield standard deviations for impulse-to-impulse variation. Examination of the individual data reveals that for each exposure condition some volunteers had levels which were different from the rest of the group. These differences are probably attributable to variation in attenuation between individuals and within individuals from one fitting to another.

The average hearing protector induced reductions in peak level, linear weighted SEL, A-weighted SEL, and P-weighted SEL were calculated by subtracting the average levels under the muffs from the average freefield levels for the condition. The average reductions are shown in tables 1 through 3. These reductions should be independent of the level of the exposure impulses if the protection is behaving linearly. For the intact muffs (left ear) at all distances and (right ear) at the 5 meter distance, this appears to be the case. For the perforated muffs at the 1 meter and 3 meter distances there appears to be a trend toward increasing attenuation as the level increases. It is not clear why these two conditions would show nonlinear attenuation behavior. The perforated muffs should not show an inherent nonlinear attenuation characteristic. We would expect that the average reduction in most of the measures would be different for the different exposure distances since the spectrum of the impulse and the attenuation characteristic of the impulse should interact to produce the signatures under the muff. While the peak reductions were about the same for all three distances, the A-weighted and P-weighted SEL reductions tended to depend on the exposure distance.

As a first step in determining which parameters derived from the measurements made under the muffs may best predict the auditory hazard, the peak level, the peak level adjusted for B-duration, and the three weighted SEL measures were compared using pair-wise correlations. Table 4 shows the matrix of these pair-wise correlations among the average values measured for all conditions under the right earcup. These correlations are based on the seven levels from the 5 m exposures, the six levels from the 3 m exposure, and five levels from the 1 m exposure, for a total of 18 values in each correlation. Table 5 shows the R^2 derived from these correlations which indicates the proportion of common variance. All of the measures are highly correlated in this set of data. Peak levels, in particular, correlate highly with all other measures. Clearly, the peak level and the peak level adjusted for B-duration are so highly correlated that it would be impossible to determine if either of these measures would be a better indicator of auditory hazard (at least in this set of data). The same can be said for the A-weighted SEL and the P-weighted SEL. In fact, A-weighted and P-weighted SEL measures share about 97 percent common variance. However, the linear weighted SEL is not as highly correlated with the other weighted SEL measures. The general high correlations among these measures may be largely due to the influence of the nearly 20 dB variation in overall level for type of impulse.

Table 1. Peak level and weighted SEL reductions in dB for the 1 meter distance.

Level	Right ear			Left ear		
	SEL			SEL		
	Peak	Linear weight	A-weight	P-weight	Peak	Linear weight
1	9.4	3.0	9.6	16.3	20.8	12.4
2	10.8	3.9	10.8	17.1	21.3	12.6
3	12.9	4.5	12.4	19.2	21.9	11.9
4	14.6	5.3	13.4	18.9	21.7	11.3
5	16.7	8.5	17.1	21.4	21.7	11.7
6	Lost					
7	Lost					
Average	12.9	5.0	12.7	18.6	21.5	12.0
Standard deviation	2.9	2.1	2.9	2.0	0.4	0.5
					0.4	0.4
					23.1	31.3
					0.7	

Table 2. Peak level and weighted SEL reductions in dB for the 3 meter distance.

Level	Right ear			Left ear		
	Peak	SEL		Peak	SEL	
		Linear weight	A-weight		P-weight	Linear weight
1	Lost					
2	12.0	5.3	13.1	19.4	21.6	14.3
3	11.4	5.4	13.1	19.0	21.3	14.1
4	13.3	6.6	14.9	19.9	25.3	17.3
5	12.2	6.8	13.9	18.7	20.9	13.7
6	14.7	8.7	16.0	20.5	23.1	15.0
7	16.6	11.5	18.4	22.9	23.8	17.2
Average	13.4	7.4	14.9	20.0	22.7	15.3
Standard deviation	1.9	2.4	2.1	1.5	1.7	1.6
						25.3
						2.0
						1.8

Table 3.
Peak level and weighted SEL reductions in dB for the 5-meter distance.

Level	Right ear				Left ear			
	Peak	SEL			Peak	SEL		
		Linear weight	A-weight	P-weight		Linear weight	A-weight	P-weight
1	13.3	7.4	19.2	23.6	13.2	6.6	19.9	24.5
2	13.8	6.6	20.6	26.8	14.2	6.4	21.0	28.3
3	14.3	6.8	20.8	27.1	14.4	6.5	20.9	29.0
4	13.8	5.4	19.8	25.9	13.5	5.1	20.2	28.0
5	12.8	3.8	17.4	23.1	12.8	4.0	18.0	25.5
6	12.8	4.2	17.8	23.5	12.7	4.6	18.4	25.9
7	12.6	3.8	15.4	21.2	13.4	4.5	16.6	23.8
Average	13.3	5.4	18.7	24.5	13.5	5.4	19.3	26.4
Standard deviation	0.6	1.5	2.0	2.2	0.7	1.1	1.7	2.0

Table 4.

Pair-wise correlations among selected parameters calculated from the pressure-time signature measured under the right earcup.

Parameters	Peak level	Peak level-B-duration	Linear weighted SEL	A-weighted SEL	P-weighted SEL
Peak level	1.0				
Peak level - B-duration	0.99	1.0			
Linear weighted SEL	0.92	0.89	1.0		
A-weighted SEL	0.95	0.98	0.80	1.0	
P-weighted SEL	0.96	0.97	0.79	0.99	1.0

Table 5.

R^2 derived from pair-wise correlations among selected parameters calculated from the pressure-time signature measured under the right earcup.

Parameters	Peak level	Peak level-B-duration	Linear weighted SEL	A-weighted SEL	P-weighted SEL
Peak level	1.0				
Peak level - B-duration	0.99	1.0			
Linear weighted SEL	0.85	0.79	1.0		
A-weighted SEL	0.91	0.95	0.63	1.0	
P-weighted SEL	0.91	0.94	0.62	0.97	1.0

In order to examine how well the various parameters measured under the muffs related to the hazard as indicated by the TTS observed in the human volunteers, the percent confidence that 95 percent of the population was protected for each condition were plotted as a function for the three SEL measures and the peak level (with number of impulses, N, incorporated as $10 \cdot \log(N)$) and the peak level corrected for B-duration and number of impulses according to MIL-STD-1474C ($5 \cdot \log(N)$). These results are shown in figures 5 through 9. In these plots, any measure which is a good indicator of hazard should organize the data onto a single curve with little spread. Notice that the three SEL graphs show about the same amount of spread in the data. However, the MIL-STD-1474C graph (figure 9) shows less spread in the data than the SEL graphs. Figures 10 through 14 show the relationship of the percent of the volunteers who had a significant TTS ($TTS > 25$ dB) to each of the potential hazard indicators. Again, the least spread in the data is seen in the MIL-STD-1474C graph (figure 14).

Closer examination of these data indicated that the main differences between the SEL and the MIL-STD-1474C treatment of the TTS data were related to the number-intensity trading rules. The SEL assumed that for constant hazard the level should be reduced by 10 dB for a 10 fold increase in number of impulses, i.e., a correction of $10 \cdot \log(N)$ was made to the single shot SEL to adjust for the number of impulses. The MIL-STD-1474C rule indicates that only a 5 dB reduction is needed for the 10 fold increase in number of impulses, i.e., a $5 \cdot \log(N)$ correction is used for the number of impulses. In figures 15 and 16, we changed the MIL-STD-1474C number-intensity trading rule to be $10 \cdot \log(N)$, the same as the SEL measures. The spread in the data was now as great as it was for the SEL measures. Thus, it appears the number-intensity trading rule of $10 \cdot \log(N)$ does not fit these data as well as a $5 \cdot \log(N)$ rule. This suggests that other trading rules might fit the data even better.

The best way to compare various measures of auditory hazard is to explore their behavior at the threshold of auditory effects (Patterson, 1991a). In order to explore this number-intensity trading rule further, the threshold of auditory effects was determined for each number impulses at each distance. This threshold was estimated two ways. First, the level at which the confidence that 95 percent of the population is protected drops to 50 percent was calculated using linear interpolation between the exposure levels. This is a level at which we can be equally confident that 95 percent of the population is and is not protected. The second method used the level at which 5 percent of the volunteers showed an unacceptable TTS, again using linear interpolation of percent unacceptable TTS between exposure levels. It should be noted that only data in which an auditory effect was seen were used in this analysis. The 5 meter distance showed no significant TTS for any exposure conditions with the unmodified muffs, so none of these data were used in this analysis. There was an auditory effect for all five number-of-impulse conditions at both the 1 meter and the 3 meter distances. This made a total of 10 thresholds in each of the variance calculations. The variance of these thresholds is an inverse indicator of how well any hazard prediction measure assesses the hazard. Table 6 shows the variance of the three SEL measures, the peak level, and the MIL-STD-1474C rule. The SEL and peak levels are all

Table 6.
Variance of measures of auditory hazards at the threshold of auditory effects.

Threshold procedure	Linear-weight SEL	A-weight SEL	P-weight SEL	Peak Level	MIL-STD-1474
50% confidence	11.5	13.4	10.0	11.4	1.7
95% protection	13.3	14.8	10.8	12.6	2.3

adjusted by adding $10 \cdot \log(N)$ for number of impulses, while the MIL-STD-1474C rule uses the adjustment of $5 \cdot \log(N)$. This confirms the observation that the MIL-STD-1474C rule fits better than any of the SEL measures. Given the high correlation between the peak level and the peak level adjusted by B-duration measures (uncorrected for number-intensity trading rules) in table 4, it would seem that this apparent advantage for the MIL-STD-1474C rule is due largely to its treatment of the number of impulses. To explore the possibility that a trading rule other than $5 \cdot \log(N)$ is optimal, the single impulse SEL values for each intensity and the peak levels and peak levels adjusted for B-duration (MIL-STD-1474C rule) were used as basic metrics. These were then modified using various number-intensity trading rules from 1 dB per 10 fold change in number to 10 dB per 10 fold change in number, i.e., $b \cdot \log(N)$ for $b=1,2,3,4,5,10$ were used. Figure 17 shows the variance of the threshold of auditory effects based on 50 percent confidence in 95 percent protection for the modified linear-weighted, A-weighted, and P-weighted SEL; the peak level without regard to B-duration; and the modified MIL-STD-1474C rule (including B-duration adjustment) as a function of the number-intensity trading rule. There is a broad minimum in all the measures except linear-weighted SEL near 3 dB per 10 fold change in number. There is very little difference among the variances from 1 to 5 dB per 10 fold change in number. Figure 18 shows the variance of the threshold of auditory effects based on the point estimates of 95 percent protection for the modified linear-weighted, A-weighted, and P-weighted SELs the peak level without regard to B-duration; and the modified MIL-STD-1474C rule (including B-duration adjustment) as a function of the number-intensity trading rule. There is a broad minimum in all the measures except linear-weighted SEL near 2 dB per 10 fold change in number. Again, there is very little difference among the variances from 1 to 5 dB per 10 fold change in number. It should be noted also that there is little difference in the variance of threshold between the peak level, modified MIL-STD-1474C rule, and the A-weighted SEL as long as the same number intensity trading rule is used. P-weighted SEL has lower variance at 10 dB per 10 fold change in number and is almost indistinguishable from the A-weighted and peak based measures at 5 dB, which appears to be its minimum. Table 7 gives the average values and standard deviations of these five measures for the 3 dB and the 2 dB per 10 fold change in number of impulses trading rules. The average values in this table could be taken as the maximum levels for a single impulse under an earmuff which are consistent with protection of 95 percent of the exposed population.

Table 7.

Average values and standard deviations of the five basic hazard indicators in dB at the threshold of significant TTS adjusted for number of impulses by $b \cdot \log(N)$.

Threshold procedure	(b)		Linear SEL	A-weight SEL	P-weight SEL	Peak Level	Peak + B-duration
95% protection	3	Average	152.7	140.1	136.1	178.4	174.1
		Standard deviation	0.8	0.9	1.4	0.9	0.8
	2	Average	151.3	138.7	134.7	177.1	172.7
		Standard deviation	0.8	0.7	1.4	0.9	0.7
50% confidence	3	Average	152.3	139.8	135.5	178.0	173.7
		Standard deviation	0.7	0.8	1.4	0.8	0.7
	2	Average	151.0	138.4	134.1	176.6	172.3
		Standard deviation	0.8	0.7	1.5	0.9	0.8

Earlier, we examined the pair-wise correlations between the basic parameters across all levels for single impulse values. These correlations were generally high. In order to examine the correlations among these parameters at the threshold of auditory effects, we also calculated pair wise correlations among the five metrics, including the 3 dB per 10 fold change in number adjustment. Table 8 shows the correlations for the 50 percent confidence threshold of effect, and table 9 shows the correlations for the 95 percent adequate protection thresholds. These are the correlations between the individual values which made up the averages shown in table 7 for $b=3$. In both cases, the two peak measures correlate very highly as might be expected. The remaining correlations are lower than might have been expected based on the earlier correlations. The most obvious interpretation of this difference is that we have eliminated the inherent correlation due to large changes in overall intensity and we have minimized the variance due the number of impulses; therefore, these correlations are more reflective of the correlations or lack of correlations between the basic parameters. Linear weighted energy is still highly correlated with all of the measures. The A-weighted and P-weighted SELs are still correlated. In addition, P-weighted SELs and the modified MIL-STD-1474 are showing a high correlation, also. These high inter-correlations suggest that these data will not provide clear evidence that any one of these measures are a better predictor of auditory effects than the others.

Table 8.

Pair-wise correlations among selected parameters calculated from the pressure-time signature measured under the right earcup at the threshold of 50 percent confidence in 95 percent protection using 3·log(N) adjustment for number of impulses.

Parameters	Peak level	Peak level-B-duration	Linear weighted SEL	A-weighted SEL	P-weighted SEL
Peak level	1.0				
Peak level - B-duration	0.97	1.0			
Linear weighted SEL	0.82	0.82	1.0		
A-weighted SEL	0.09	0.21	0.59	1.0	
P-weighted SEL	0.67	0.65	0.87	0.53	1.0

Table 9.

Pair-wise correlations among selected parameters calculated from the pressure-time signature measured under the right earcup at the threshold of 95 percent protection using 3·log(N) adjustment for number of impulses.

Parameters	Peak level	Peak level-B-duration	Linear weighted SEL	A-weighted SEL	P-weighted SEL
Peak level	1.0				
Peak level - B-duration	0.95	1.0			
Linear weighted SEL	0.83	0.84	1.0		
A-weighted SEL	0.32	0.47	0.75	1.0	
P-weighted SEL	0.64	0.58	0.84	0.68	1.0

We have used a calculation based on MIL-STD-1474C or a modification of this procedure. It should be remembered that the use of the limit values in MIL-STD-1474C for pressure time signatures measured under the muffs is not appropriate since they already include an allowance for hearing protection. To illustrate this, we calculated adjusted MIL-STD-1474C limits in dB for comparison with the values in table 7. If we remove the 29 dB allowed for single protection, the 100 impulse limit in MIL-STD-1474C is 138 dB (peak level + 6.64·log(B-duration/200), for B-durations less than or equal to 200 ms). If we then adjust this limit to 1 impulse using the 5·log(N) rule in MIL-STD-1474C, we get a limit value of 148 dB. The peak +B-duration limits in table 7 are 172 to 174 dB, 24 to 26 dB higher.

Conclusions

The results of these studies clearly indicate the conventional criteria (CHABA, 1968) overestimate the hazard to hearing when applied to measurements under hearing protection. The MIL-STD-1474C criteria applied to the pressure-time signatures outside the hearing protection are also overly conservative. The results indicate that a criterion could be established using the peak level, the peak level adjusted for B-duration, A-weighted SEL, or P-weighted SEL under hearing protection as the single impulse hazard indicator if the appropriate number-intensity trading rule is used. The results reported here suggest that a trading rule between 1 and 5 dB per 10 fold change in number of impulses is consistent with the TTS data from the freefield studies, with 2 or 3 dB providing the best fit. For these number-intensity trading rules, the peak level, the peak level corrected for B-duration and the A-weighted SEL (for one impulse) are equivalent based on a minimum variance in the threshold of auditory effect criterion. P-weighted SEL and linear weighted SEL are not as good using this minimum variance criterion.

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Figure 1. Typical volunteer with earmuffs, helmet, and eye protection.

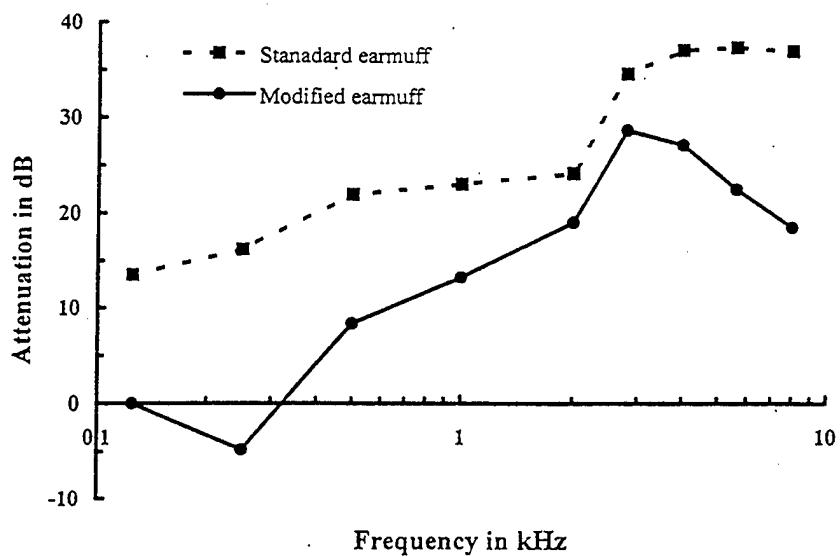


Figure 2. Attenuation characteristic of the modified muff (right ear) and unmodified muff (left ear).

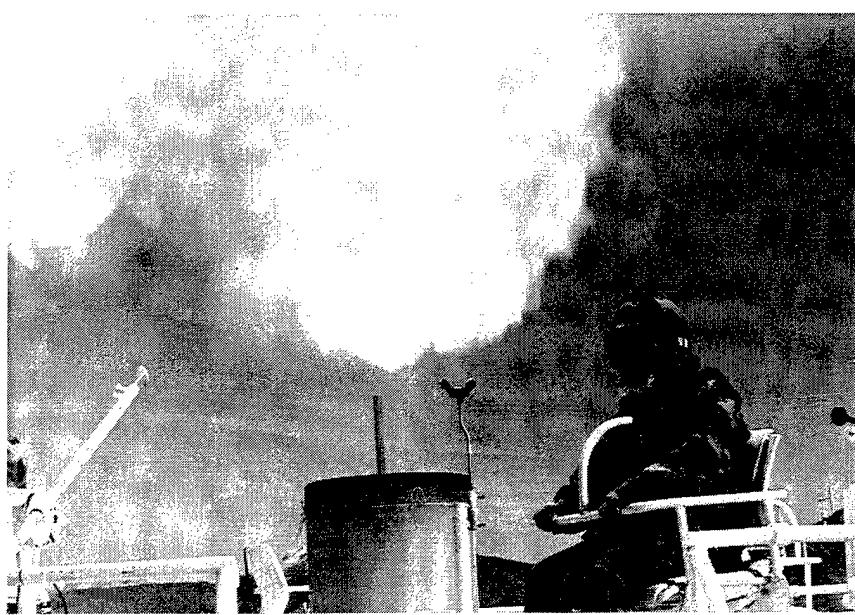


Figure 3. Typical volunteer during an exposure at the 3-meter distance.

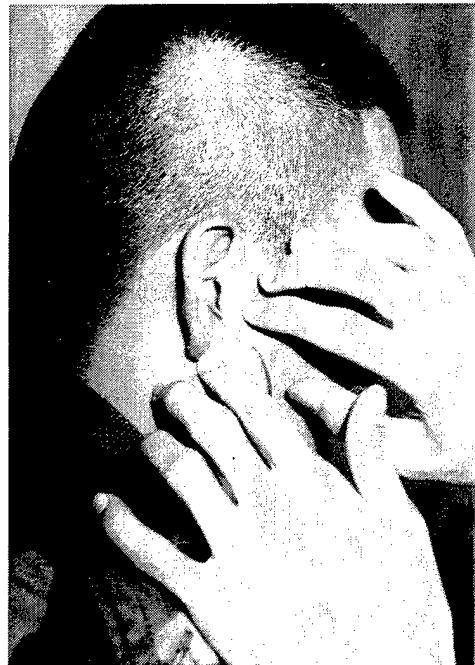


Figure 4. Typical volunteer with the under-the-muff gauge in position before the muffs were placed over the ears.

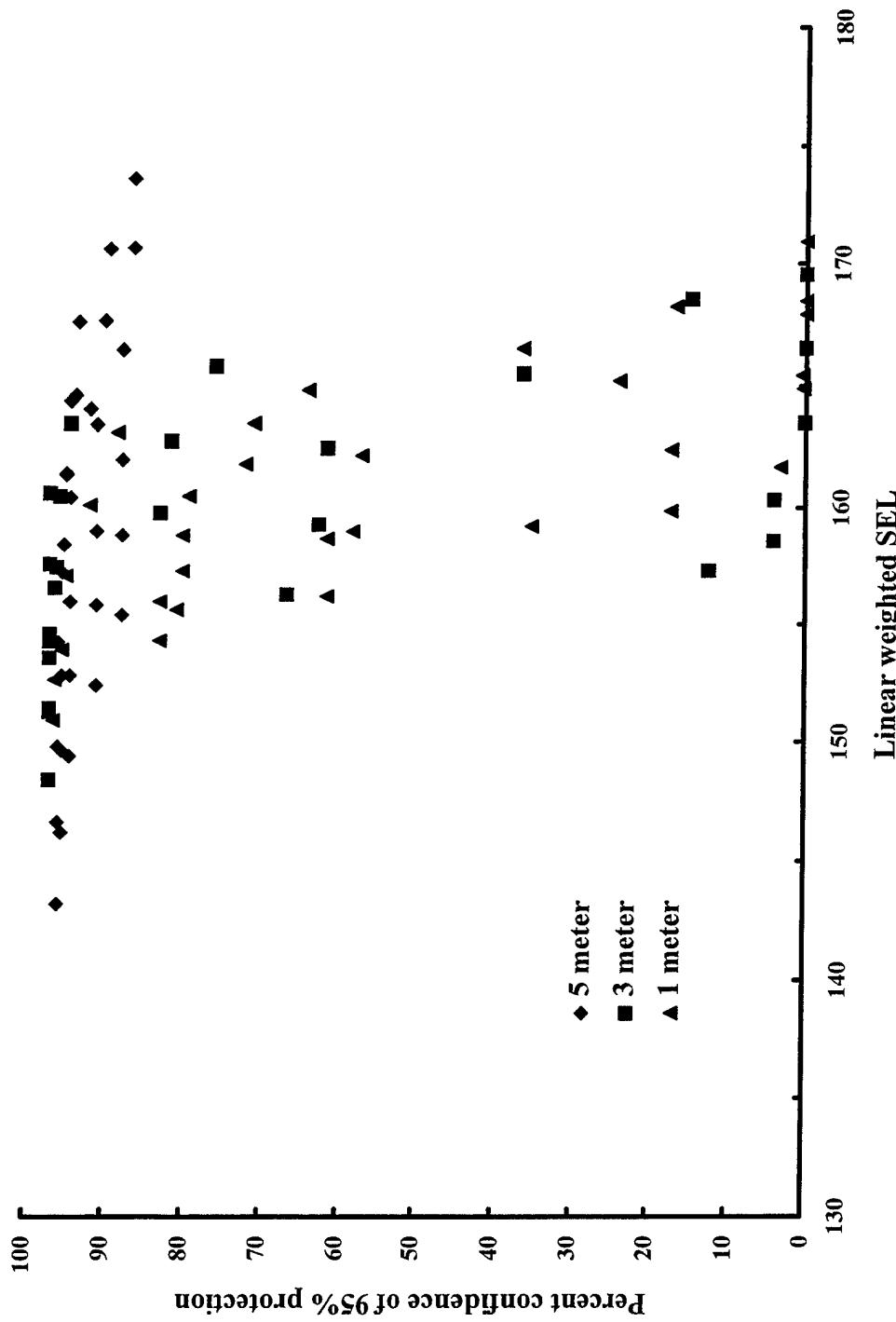


Figure 5. Percent confidence that 95 percent of the population would be protected as a function of the linear weighted SEL.

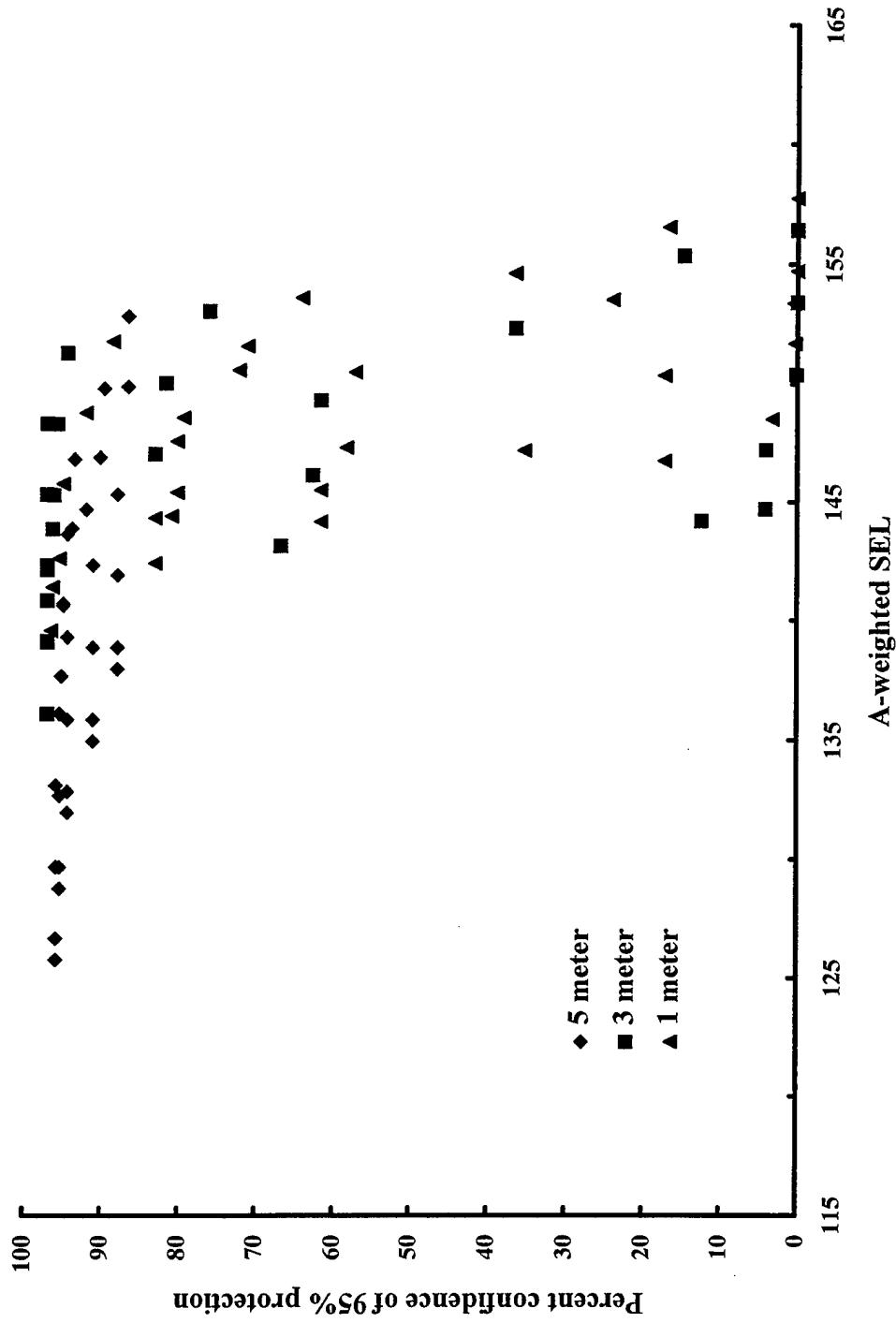


Figure 6. Percent confidence that 95 percent of the population would be protected as a function of the A-weighted SEL.

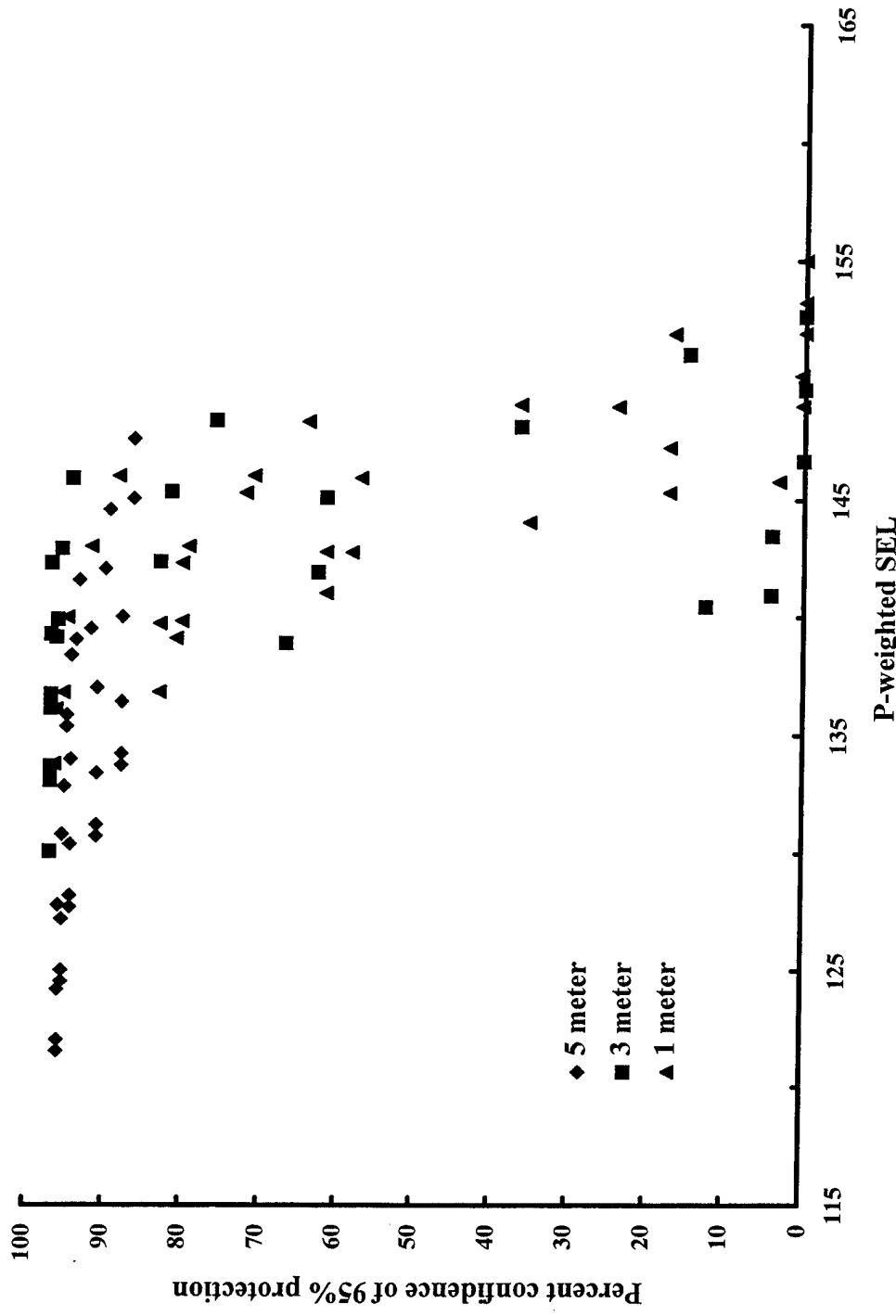


Figure 7. Percent confidence that 95 percent of the population would be protected as a function of the P-weighted SEL.

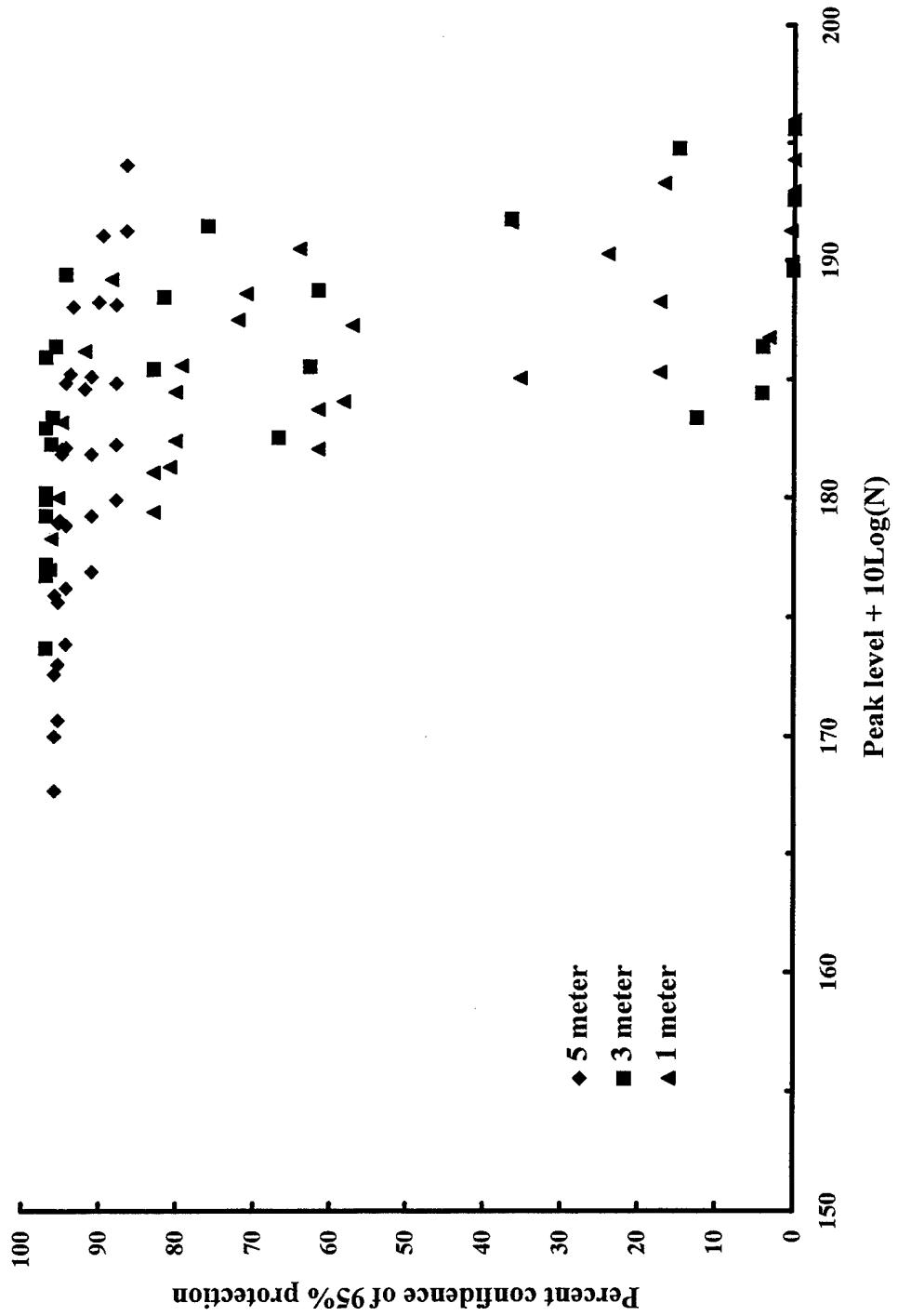


Figure 8. Percent confidence that 95 percent of the population would be protected as a function of the peak level + $10 \cdot \log(N)$.

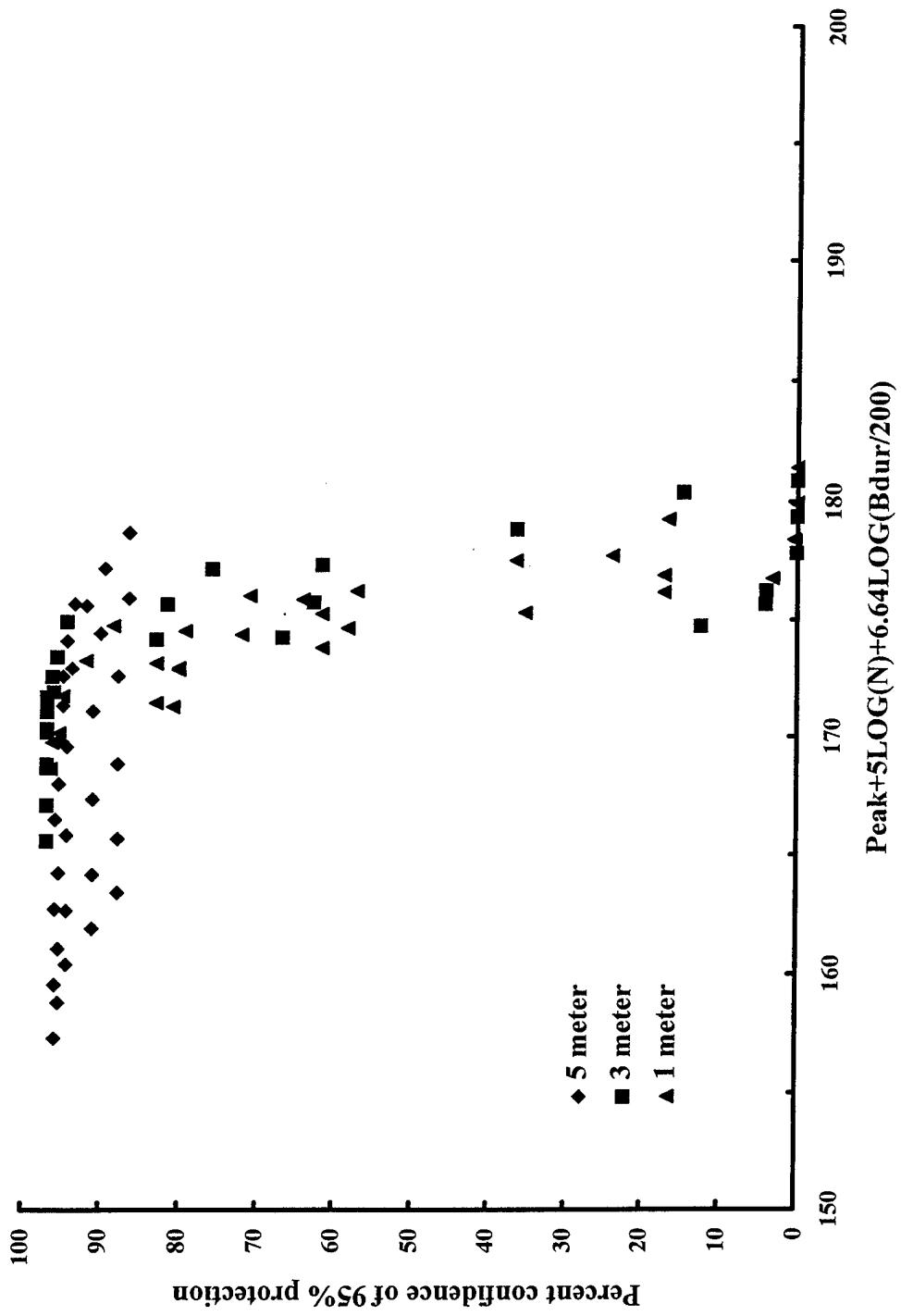


Figure 9. Percent confidence that 95 percent of the population would be protected as a function of the peak level + 5·log(N) + 6.64·log(B-duration/200).

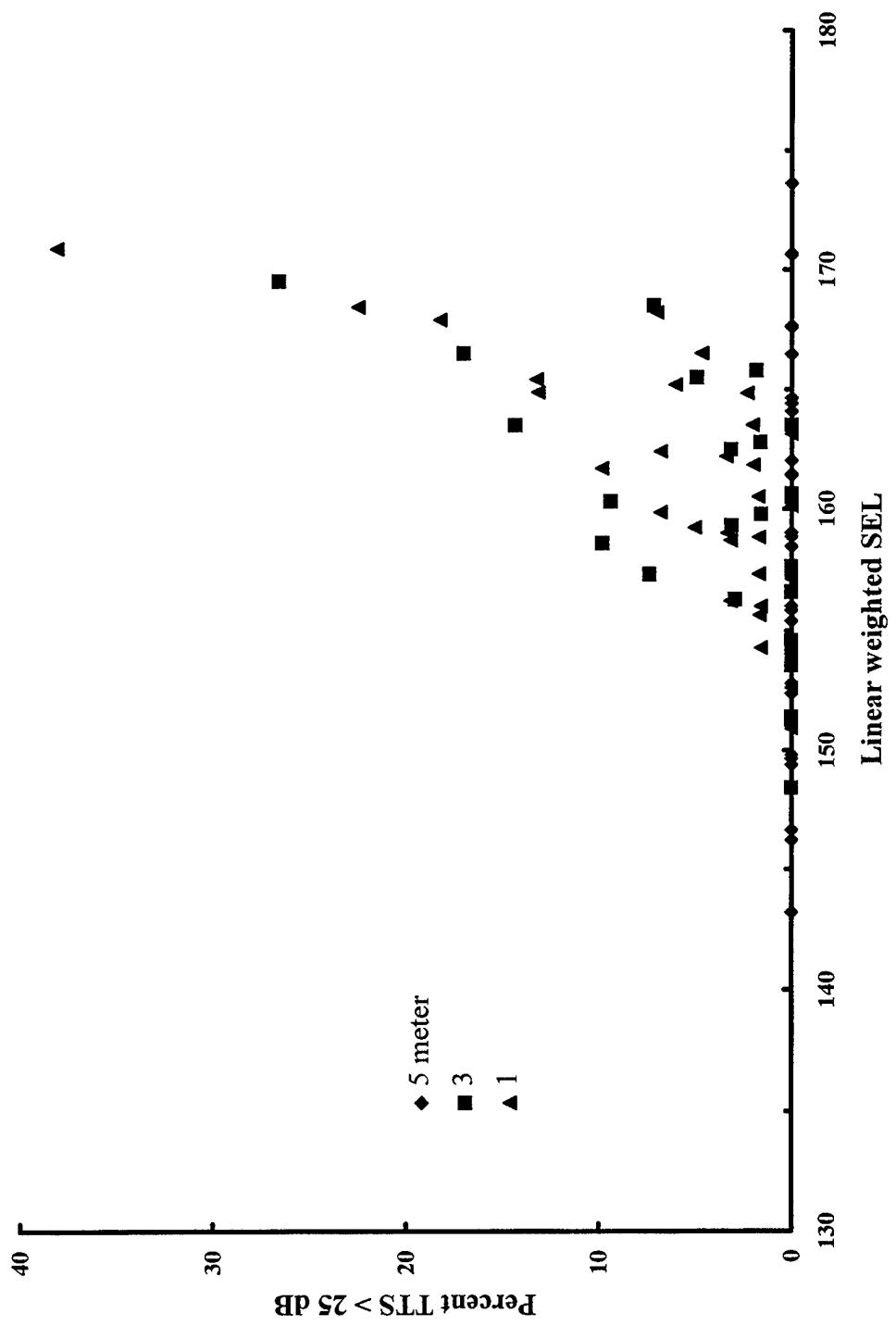


Figure 10. Percent of volunteers showing a TTS>25 dB after exposures as a function of the linear weighted SEL.

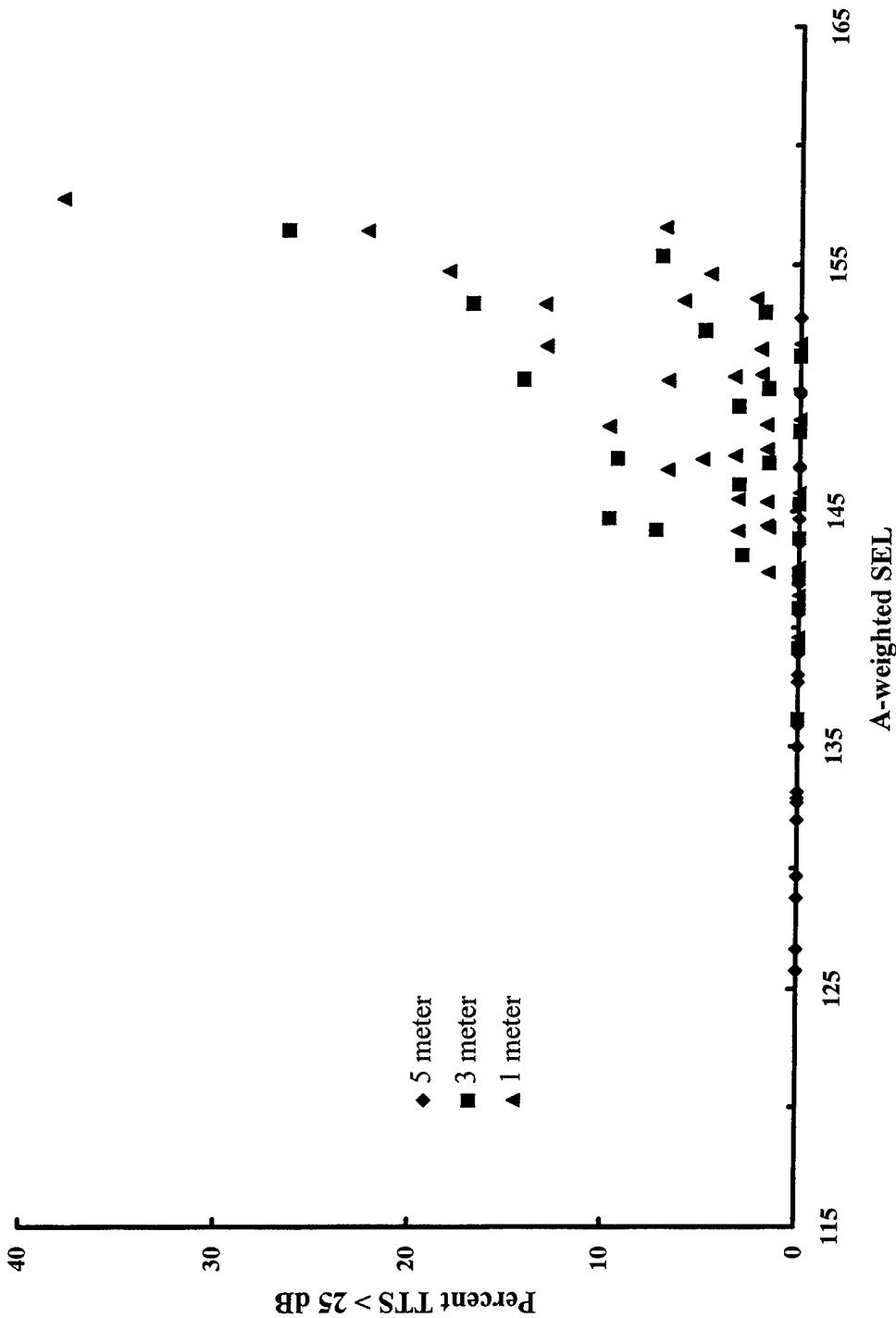


Figure 11. Percent of volunteers showing a TTS >25 dB after exposures as a function of the A-weighted SEL.

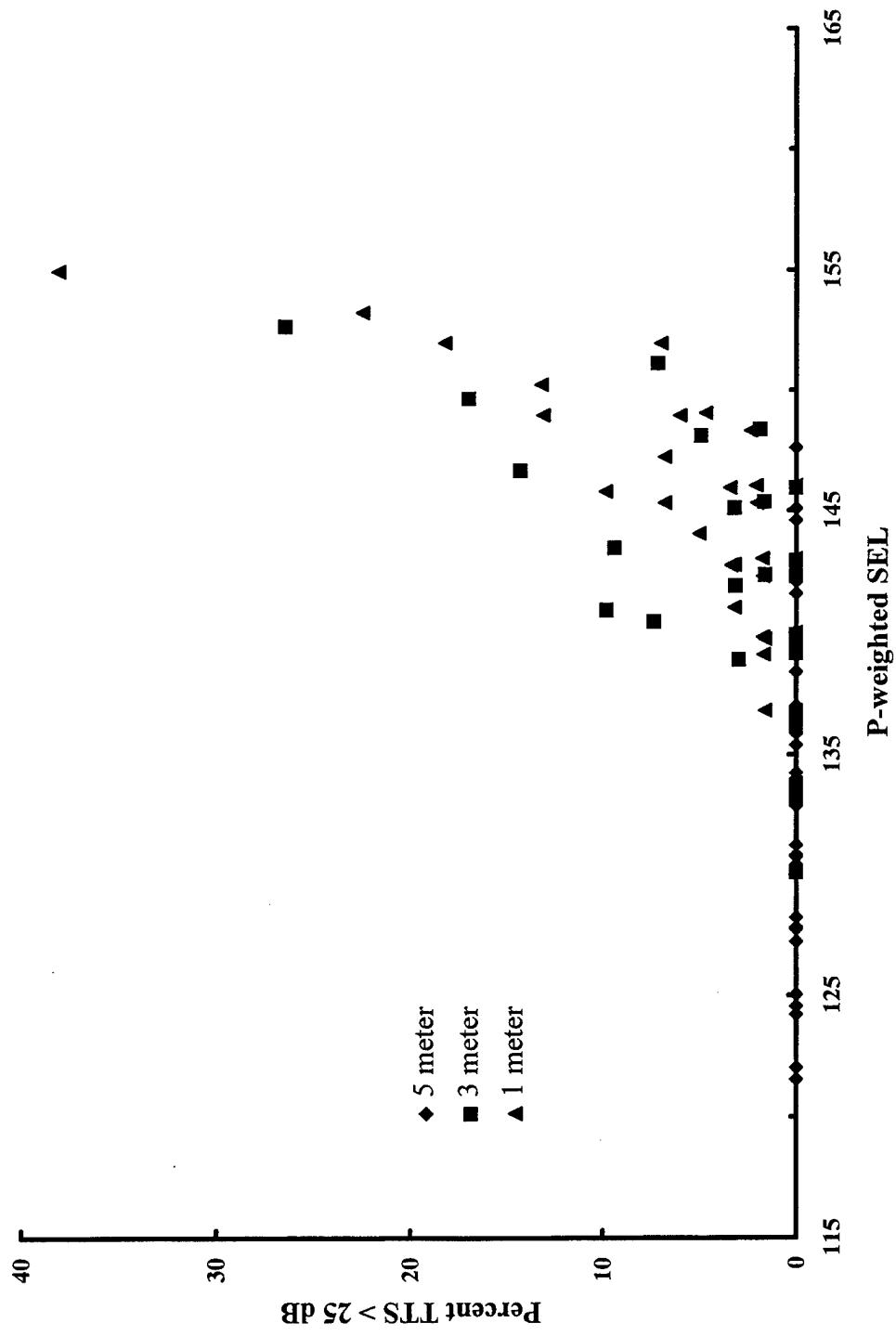


Figure 12. Percent of volunteers showing a TTS >25 dB after exposures as a function of the P-weighted SEL.

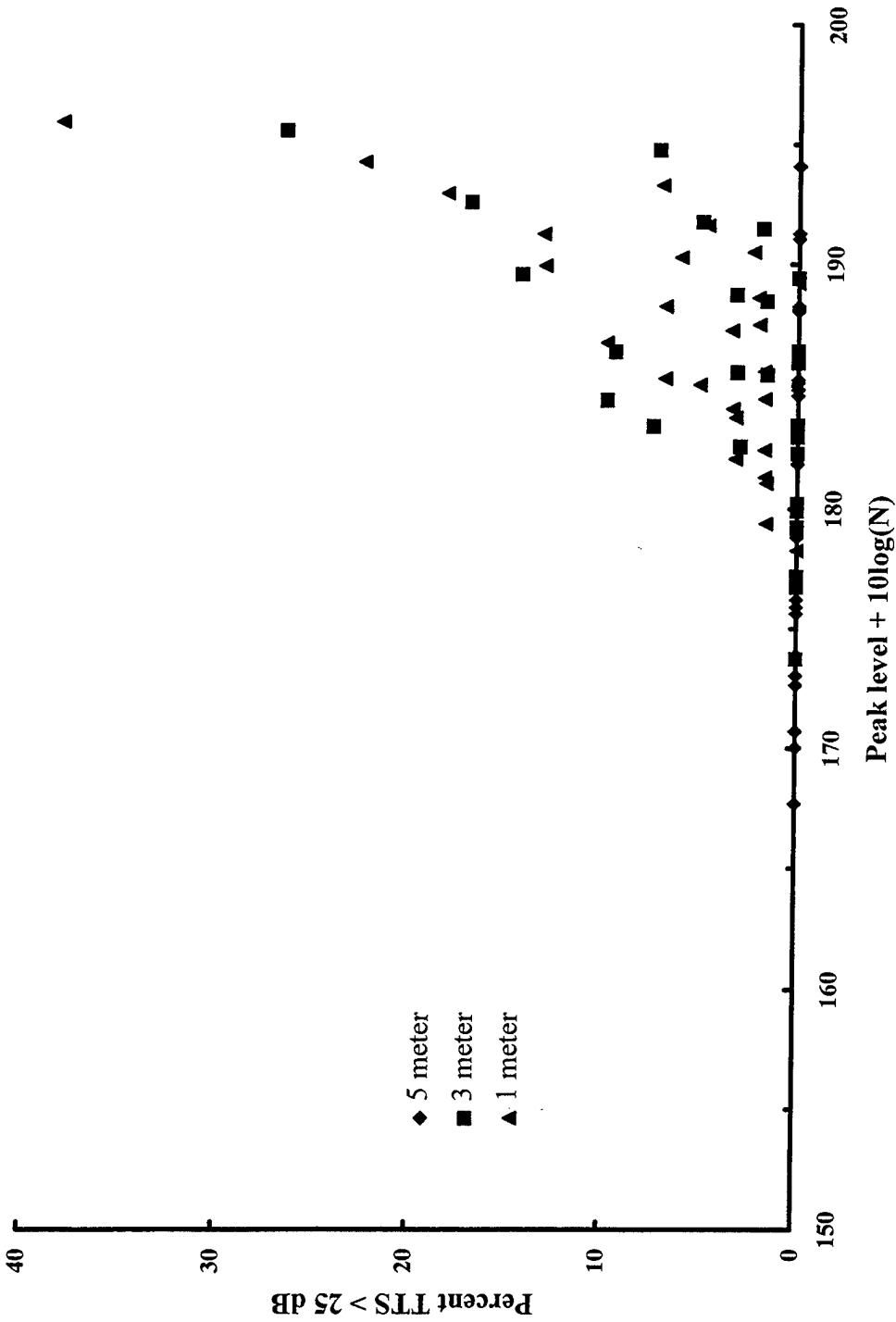


Figure 13. Percent of volunteers showing a $\text{TTS} > 25 \text{ dB}$ after exposures as a function of the peak level + $10 \cdot \log(N)$.

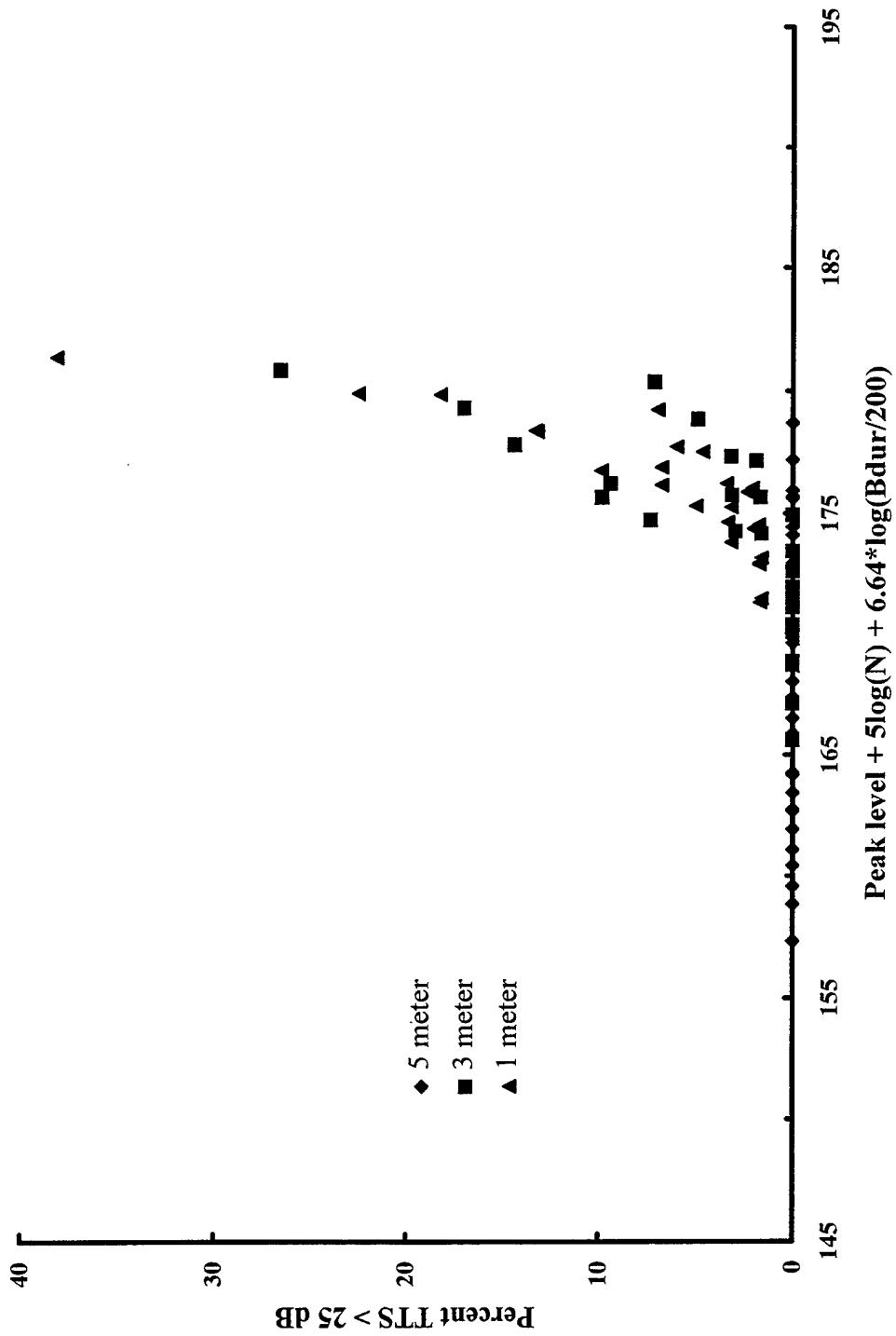


Figure 14. Percent of volunteers showing a TTS>25 dB after exposures as a function of the peak level + $5\cdot\log(N) = 6.64\cdot\log(B\text{-duration}/200)$.

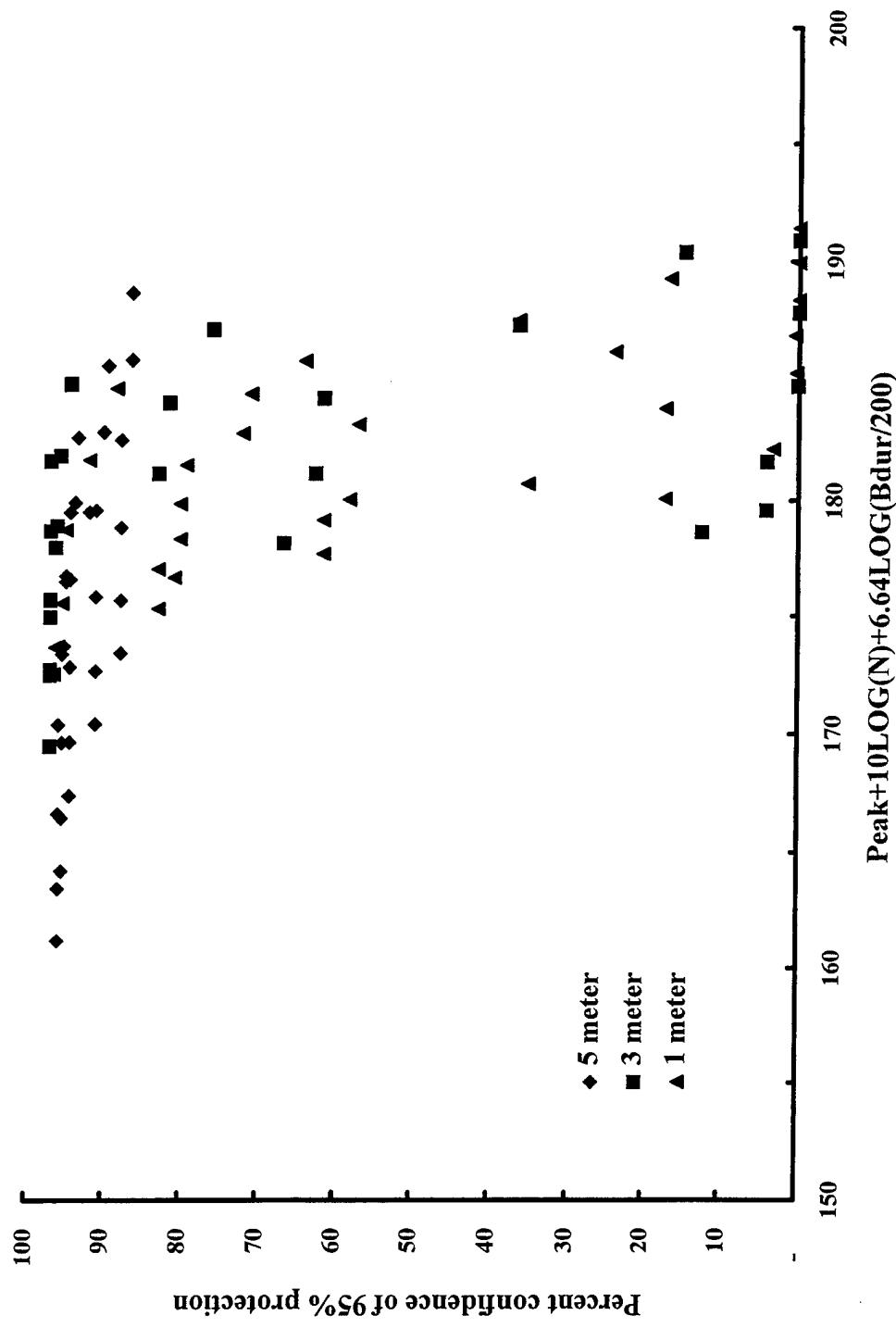


Figure 15. Percent confidence that 95 percent of the population would be protected as a function of the peak level + 10 $\log(N)$ + 6.64 $\log(B\text{-duration}/200)$.

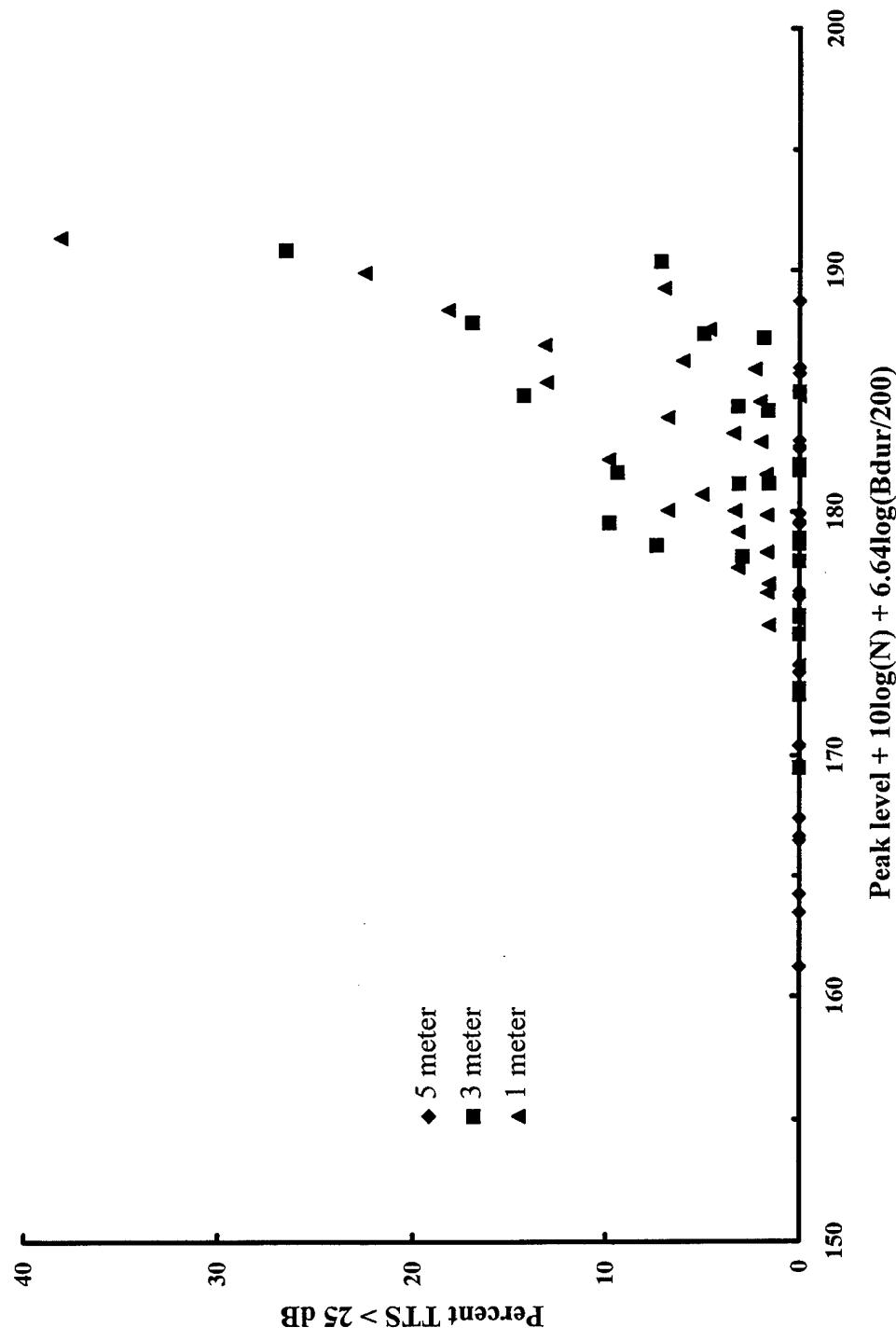


Figure 16. Percent of volunteers showing a TTS>25 dB after exposures as a function of the peak level + $10 \cdot \log(N) + 6.64 \cdot \log(B\text{-duration}/200)$.

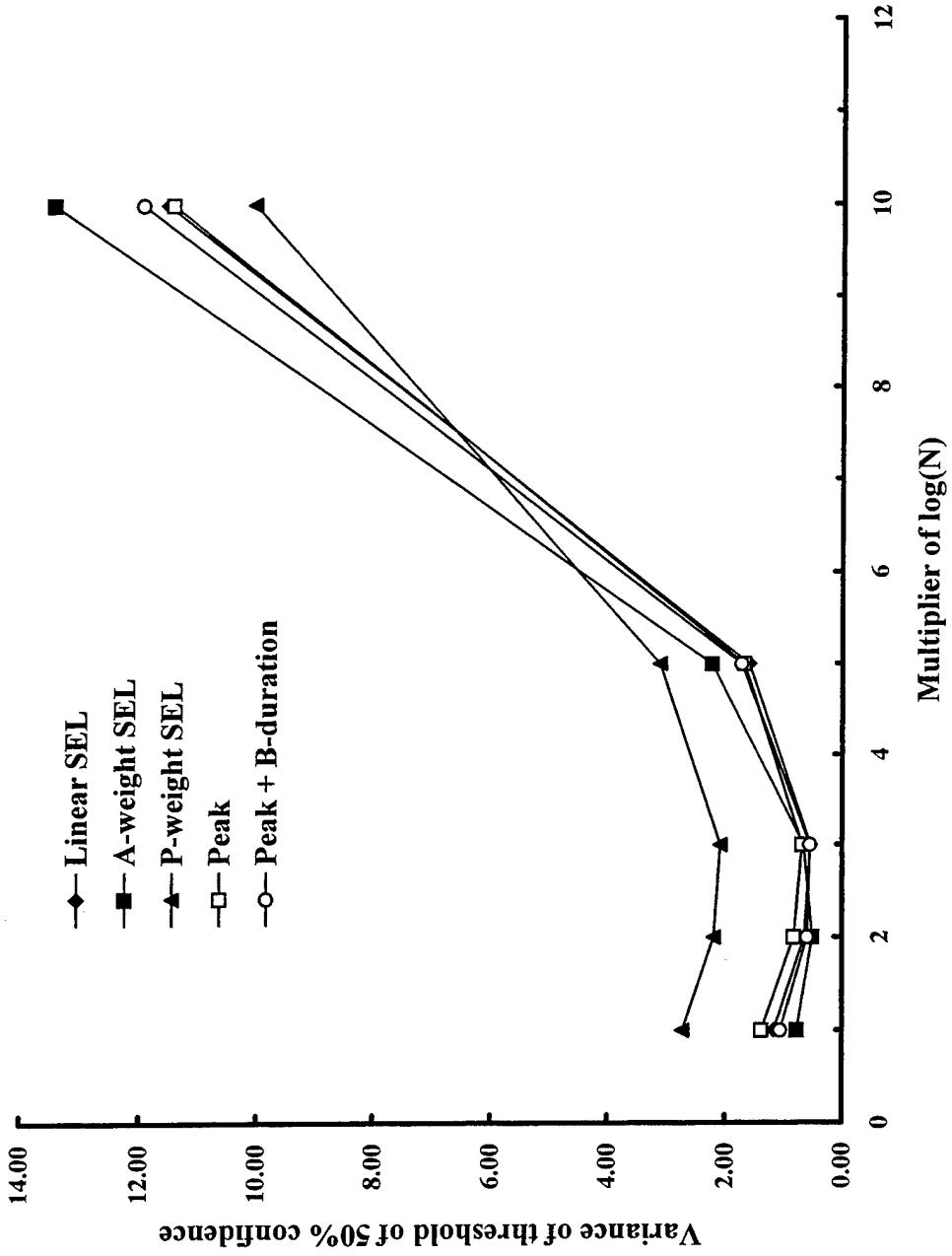


Figure 17. Variance of the threshold of 50 percent confidence that 95 percent of the population would be protected as a function of b when $b \log(N)$ is used as the number of impulses adjustment factor.

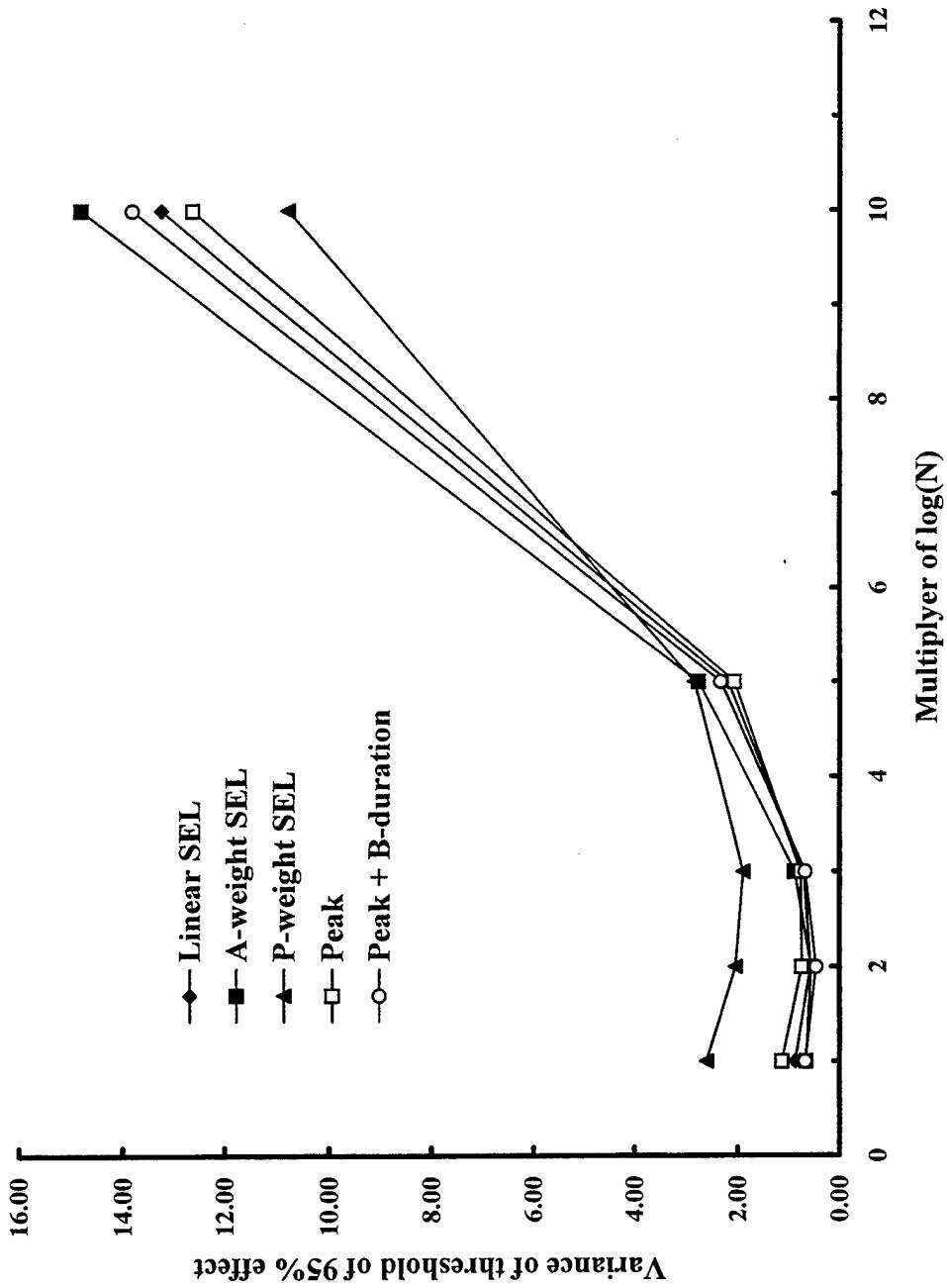


Figure 18. Variance of the threshold of 95 percent of volunteers showing a TTS<25 dB as a function of b when $b \log(N)$ is used as the number of impulses adjustment factor.

Appendix A.

Basic equations

The following equations may be useful in understanding some of the quantities used in the analysis of the data contained in this report.

The impulse noise hazard indicator level (HIL) in dB,, based on MIL-STD-1474C is:

- 1) $HIL = PPL + 6.64 \cdot \log(B\text{-duration}/200) + 5 \cdot \log(N)$ for $B\text{-duration} < 200\text{ms}$ and $N \geq 5$
- 2) $HIL = PPL + 5 \cdot \log(N)$ for $B\text{-duration} \geq 200\text{ms}$ and $N \geq 5$

Where PPL is the peak pressure level in dB SPL and N is the number of rounds. If HIL is set to 177 dB and N is set equal to 5, this equation describes the PPL as a function of B-duration at the Z-curve. If HIL is set to 177 dB, the equations can be used to solve for ANR for any PPL and B-duration.

The weighted SELs were calculated from squared magnitude of the discrete Fourier pressure spectrum using Parseval's theorem. If the discrete pressure-time signature is $p(i\Delta t)$ with pressure in Pa, then $P(i\Delta\omega)$ is the discrete Fourier transform (DFT) of $p(i\Delta t)$. The weighted SEL value for this pressure-time signature is calculated using $P(i\Delta\omega)$:

$$3) \quad SEL(W) = 10 \cdot \log [c \cdot \sum_i |P(i\Delta\omega)|^2 \cdot W(i\Delta\omega)] \quad \text{for } i = 0 \text{ to } n/2$$

Where $W(i\Delta\omega)$ is the frequency domain weighting function and c is constant which incorporates the scaling factors for $\Delta\omega$, the DFT and the square of reference pressure $400 \mu\text{Pa}^2$. The weighting function $W(i\Delta\omega)$ was either 1 for linear weighting or the A-weighting function found in sound level meters or P-weighting function defined in Patterson et al. (1993). Equation 3 gives the SEL of a single impulse. For a N impulses, the individual SEL values are combined on a pressure-squared summation basis:

$$4) \quad SEL(W) = 10 \cdot \log [\sum_j c \cdot \sum_i |P(i\Delta\omega)|^2 \cdot W(i\Delta\omega)] \quad \text{for } i = 0 \text{ to } n/2 \text{ and } j = 1 \text{ to } N$$

Which for N identical impulses gives the familiar:

$$5) \quad SEL(W) = 10 \cdot \log [c \cdot \sum_i |P(i\Delta\omega)|^2 \cdot W(i\Delta\omega)] + 10 \cdot \log(N) \quad \text{for } i = 0 \text{ to } n/2$$

Which is the implied $10 \cdot \log(N)$ rule for trading SEL for number of impulses.

In general, we could develop an exposure limit level (ELL) based on any single impulse hazard level (SIHL) measure and a number trading rule in the form:

$$6) \quad ELL = SIHL + b \cdot \log(N)$$

The SIHL could be the HIL from MIL-STD-1474, a weighted SEL or any other measure which can be calculated from a pressure-time signature and converted to dB.

Appendix B.

Pressure-time signatures and summary data tables for the 1-meter exposure distance.

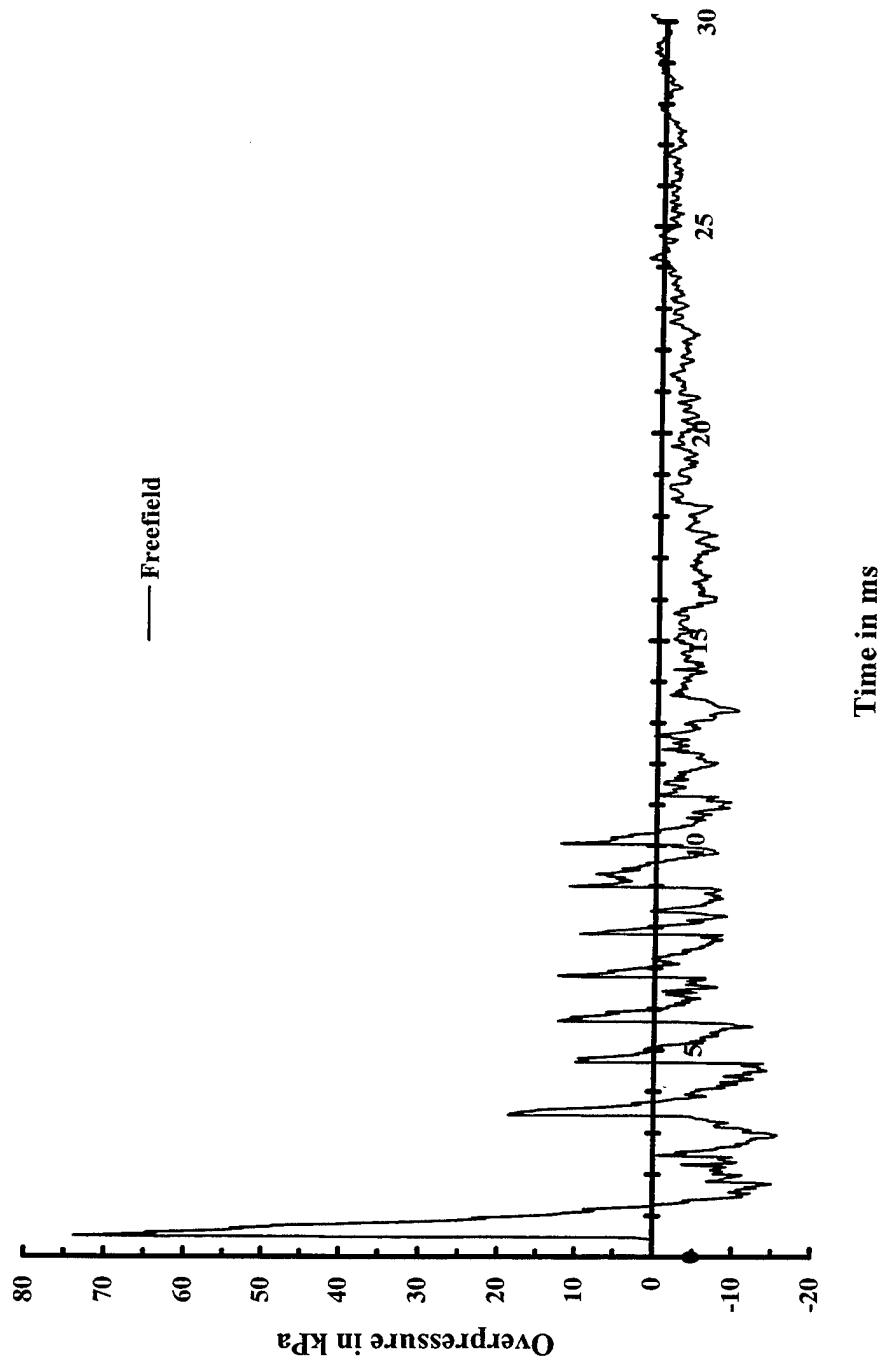
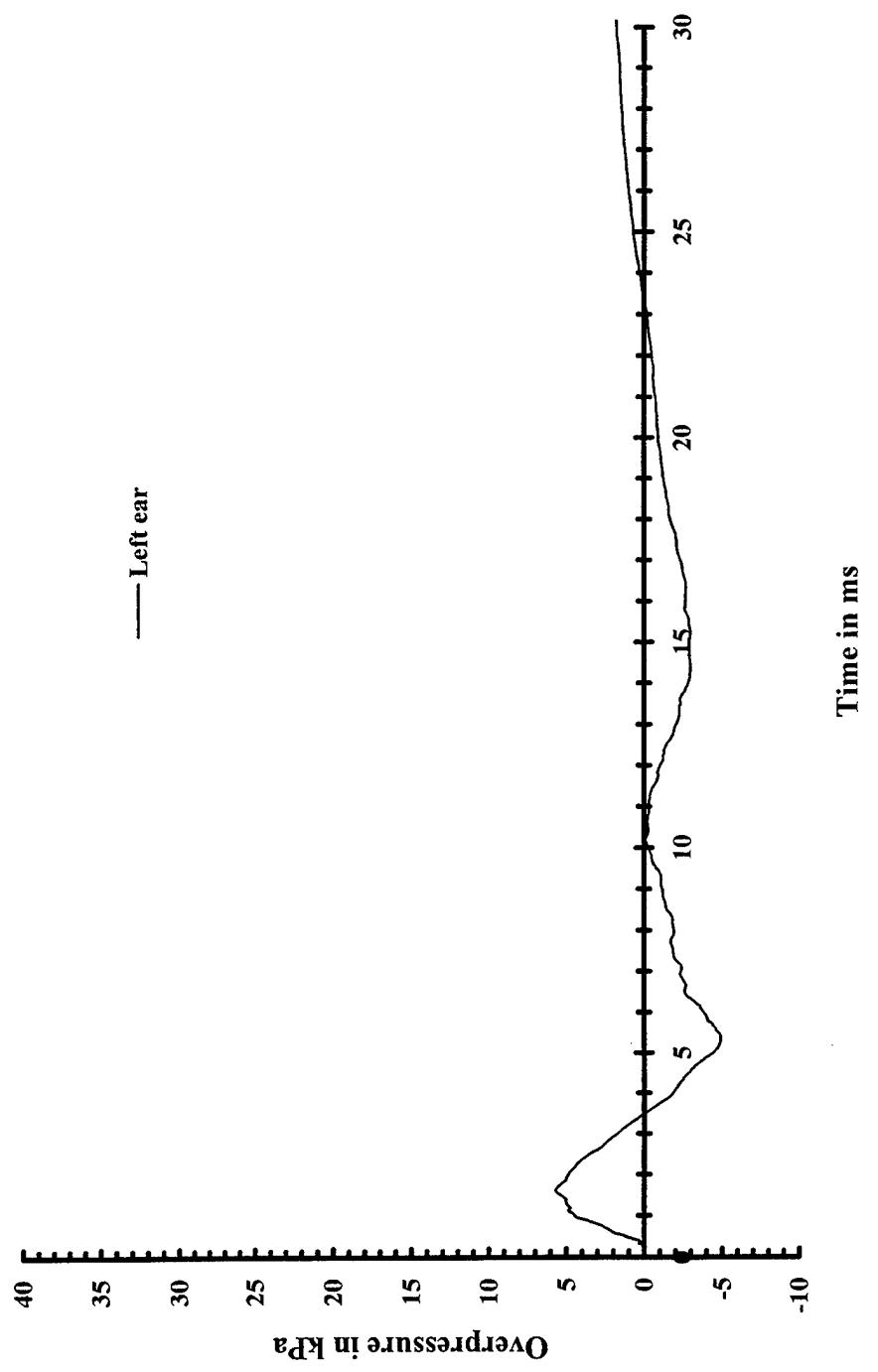


Figure B-1. Pressure-time signature measured in the freefield at the 1-meter distance.



B-3

Figure B-2. Pressure-time signature measured under the right earmuff at the 1-meter distance.

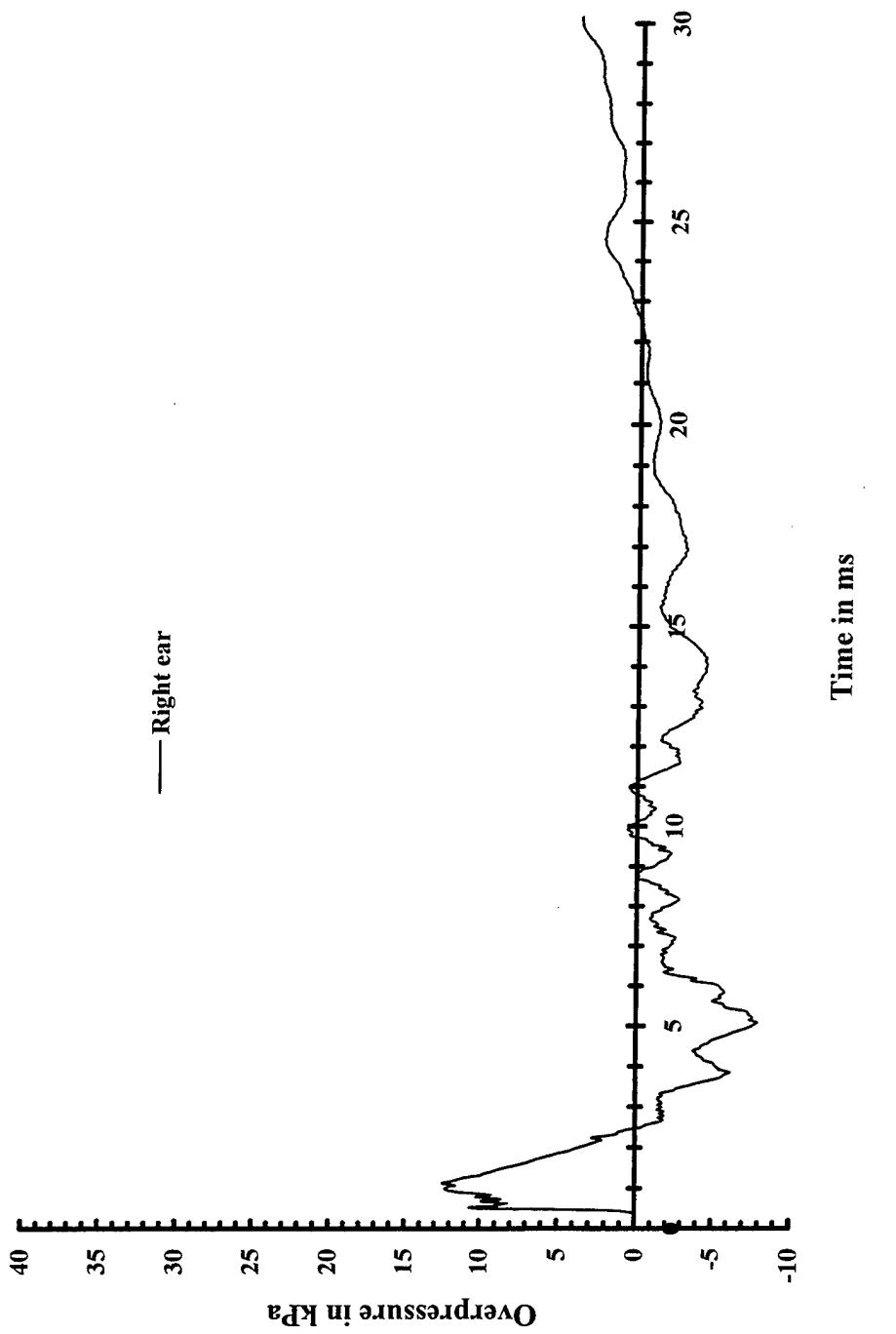


Figure B-3. Pressure-time signature measured under the left earmuff at the 1-meter distance.

Table B-1.
Average and standard deviation of selected parameters measured outside the earmuffs at the 1-meter distance.

Level	N	Peak in kPa		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m	
		A	B	A	B	Linear	A-WT	P-WT	
1	Average	12	17.07	1.09	10.67	9.09	393.15	135.00	167.99
	Standard deviation		1.39	0.09	2.71	0.21	24.14	18.48	38.52
2	Average	12	23.27	1.01	13.00	11.38	728.77	264.55	337.35
	Standard deviation		2.54	0.06	1.81	0.29	40.10	21.50	66.09
3	Average	10	33.80	0.96	11.20	14.54	1222.28	485.65	655.91
	Standard deviation		2.12	0.04	4.47	0.81	141.93	82.94	157.34
4	Average	4	49.43	0.96	11.00	19.51	2151.95	939.85	1202.08
	Standard deviation		4.23	0.03	3.37	0.65	78.54	77.47	256.30
5	Average	10	70.99	0.89	13.50	25.92	4797.10	2201.04	2847.17
	Standard deviation		8.84	0.09	3.37	1.19	505.08	442.29	634.82
6			Lost		Lost				
7									

Table B-2.

Average and standard deviation of selected parameters in dB measured outside the earmuffs at the 1-meter distance.

Level	N	Peak in dB SPL	B-duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
					Linear	A-WT	P-WT
1	Average	12	178.60	10.67	26.80	146.12	141.45
	Standard deviation	0.70	2.71	12.01	0.26	0.58	0.98
2	Average	12	181.27	13.00	5.73	148.80	144.39
	Standard deviation	0.95	1.81	2.26	0.24	0.36	0.86
3	Average	10	184.54	11.20	1.66	151.03	146.99
	Standard deviation	0.54	4.47	0.60	0.52	0.76	1.14
4	Average	4	187.84	11.00	0.34	153.51	149.90
	Standard deviation	0.76	3.37	0.06	0.16	0.35	0.92
5	Average	10	190.94	13.50	0.07	156.97	153.53
	Standard deviation	1.10	3.37	0.03	0.45	0.88	1.02
6					Lost		
7					Lost		

Table B-3.
 Between subject average and standard deviation of selected parameters measured under the muffs at the 1 meter distance.

Level	Ear	N	Peak in kPa	Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
				A	B		Linear	A-WT	P-WT
1	R	Average	6	5.83	1.97	42.94	6.64	200.82	15.01
		Standard deviation		0.86	0.10	5.35	0.56	39.10	3.88
L	Average	6	1.57	2.93	52.72	2.73	23.69	0.69	0.13
		Standard deviation		0.18	0.29	6.93	0.55	6.99	0.13
2	R	Average	6	6.74	1.92	40.53	7.53	299.69	22.70
		Standard deviation		0.78	0.07	2.94	0.78	64.64	6.02
L	Average	6	2.00	2.72	40.89	3.31	44.89	1.40	0.28
		Standard deviation		0.31	0.21	10.64	0.80	20.26	0.38
3	R	Average	6	7.73	2.01	49.06	8.68	438.86	29.32
		Standard deviation		1.37	0.11	12.95	1.08	86.01	9.59
L	Average	6	2.73	2.95	38.08	4.76	79.15	2.28	0.37
		Standard deviation		0.20	0.08	4.43	0.45	8.84	0.39
4	R	Average	2	9.28	1.97	49.75	10.59	637.42	43.73
		Standard deviation		1.34	0.15	13.79	0.56	14.95	9.49
L	Average	3	4.05	3.26	36.50	7.20	158.51	4.88	0.88
		Standard deviation		0.20	0.81	1.00	1.13	14.19	0.12
5	R	Average	6	10.51	2.15	44.50	12.15	680.31	44.29
		Standard deviation		1.97	0.08	6.03	1.93	127.45	15.38
L	Average	6	5.93	3.03	37.33	10.42	342.19	10.51	3.95
		Standard deviation		1.27	0.29	3.63	2.78	115.04	5.74
6	R	Average	6	12.74	2.96	41.11	19.11	1208.57	59.77
		Standard deviation		2.17	0.31	7.84	3.73	260.95	17.01
L	Average	5	7.90	3.16	39.03	13.57	718.52	24.03	9.91
		Standard deviation		1.93	0.19	2.58	3.04	258.99	12.19
7	R	Average	6	15.29	3.76	32.72	24.85	1558.65	79.48
		Standard deviation		2.95	0.59	0.44	2.05	145.67	26.67
L	Average	5	7.38	3.23	35.10	12.92	721.14	18.91	5.46
		Standard deviation		0.31	0.44	7.04	1.37	192.69	4.27

Table B-4.

Between subject average and standard deviation of selected parameters in dB measured under the muffs at the 1 meter distance.

Level	Ear	R	Average	N	Peak in dB SPL	B-duration in ms	ANR	Weighted SEL in db SPL		
								Linear	A-WT	P-WT
1	R	Average	6	169.21	42.94	324.27	143.14	131.80	126.02	1.74
		Standard deviation		1.35	5.35	189.01	0.85	1.22		
1	L	Average	6	157.82	52.72	45370.06	133.75	118.49	111.34	
		Standard deviation		0.99	6.93	20339.92	1.33	0.85	0.82	
2	R	Average	6	170.50	40.53	185.83	144.86	133.61	128.32	
		Standard deviation		0.99	2.94	81.97	0.96	1.15	0.94	
2	L	Average	6	159.92	40.89	32283.57	136.25	121.47	114.16	
		Standard deviation		1.38	10.64	31212.57	2.18	1.24	1.41	
3	R	Average	6	171.61	49.06	88.90	146.53	134.61	129.05	
		Standard deviation		1.65	12.95	41.66	0.89	1.62	2.03	
3	L	Average	6	162.67	38.08	7035.27	139.13	123.71	115.77	
		Standard deviation		0.62	4.43	1387.67	0.49	0.72	0.79	
4	R	Average	2	173.28	49.75	36.61	148.22	136.54	131.96	
		Standard deviation		1.26	13.79	7.50	0.10	0.95	1.18	
4	L	Average	3	166.11	36.50	1576.24	142.16	127.05	119.61	
		Standard deviation		0.44	1.00	139.51	0.40	0.12	0.36	
5	R	Average	6	174.26	44.50	32.75	148.44	136.39	133.26	
		Standard deviation		1.63	6.03	20.32	0.80	1.53	2.14	
5	L	Average	6	169.25	37.33	447.21	145.28	129.81	124.12	
		Standard deviation		1.95	3.63	352.24	1.66	2.28	3.02	
6	R	Average	6	175.95	41.11	15.97	150.92	137.73	135.00	
		Standard deviation		1.61	7.84	9.80	0.91	1.44	1.94	
6	L	Average	5	171.69	39.03	134.63	148.41	133.39	128.66	
		Standard deviation		1.93	2.58	83.94	2.06	2.52	3.61	
7	R	Average	6	177.52	32.72	10.99	152.09	138.97	137.55	
		Standard deviation		1.63	0.44	7.04	0.41	1.45	2.72	
7	L	Average	5	171.31	35.10	150.86	148.62	132.83	127.33	
		Standard deviation		0.36	7.04	48.71	1.23	1.00	0.85	

Table B-5.
Average and standard deviation of selected parameters measured under the muffs of individual subjects
at the 1 meter distance, level 1.

Subject	Ear		N	Peak in kPa	Durations in ms		A-impulse in		Weighted energy in J/m*m			
							A		B		kPa*ms	
					A	B	Linear	P-WT	A-WT	P-WT		
DDG1	R	Average	3	6.08	1.89	44.33	6.82	225.46	17.50	4.15		
DDG1	L	Average	3	0.00	0.02	9.24	0.16	5.44	1.52	0.42		
DDG3	R	Average	3	1.58	2.89	56.00	2.67	27.63	0.78	0.13		
DDG3	R	Standard deviation	0.03	0.02	0.00	0.08	2.55	0.07	0.01			
DDG3	L	Average	3	4.86	2.05	40.00	5.99	146.98	10.24	2.43		
DDG3	L	Standard deviation	0.15	0.01	0.00	0.06	4.10	0.41	0.15			
DDG5	R	Average	3	1.73	3.30	46.00	3.33	32.21	0.72	0.13		
DDG5	R	Standard deviation	0.02	0.01	8.66	0.08	1.83	0.04	0.01			
DDG5	L	Average	3	4.64	2.10	53.00	6.25	192.21	10.24	2.42		
DDG5	L	Standard deviation	0.16	0.00	4.36	0.06	4.13	0.19	0.18			
DDH1	R	Average	3	1.54	2.65	42.00	2.44	17.47	0.78	0.16		
DDH1	R	Standard deviation	0.04	0.03	2.65	0.07	0.35	0.02	0.01			
DDH1	L	Average	3	6.30	1.84	39.00	6.41	198.88	17.41	6.90		
DDH1	L	Standard deviation	0.19	0.06	0.00	0.13	2.23	1.91	1.41			
DDH3	R	Average	3	1.30	2.61	57.67	2.03	15.36	0.50	0.09		
DDH3	R	Standard deviation	0.06	0.03	17.01	0.06	1.63	0.04	0.01			
DDH3	L	Average	3	6.42	1.97	39.00	6.76	180.27	15.47	4.37		
DDH3	L	Standard deviation	0.31	0.03	1.00	0.27	5.63	0.68	0.47			
DDH5	R	Average	3	1.78	3.23	58.33	3.44	29.51	0.80	0.15		
DDH5	R	Standard deviation	0.12	0.05	7.77	0.10	2.35	0.11	0.01			
DDH5	L	Average	3	6.69	1.96	42.33	7.59	261.12	19.22	4.48		
DDH5	L	Standard deviation	0.30	0.03	4.04	0.03	9.38	1.31	0.17			

Table B-6.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 1 meter distance, level 2.

Subject	Ear		N	Peak in kPa	Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
					A	B		LINEAR	A-WT	P-WT
DDG1	R	Average	3	7.39	1.88	38.00	8.01	347.64	28.10	8.17
		Standard deviation		0.23	0.02	1.00	0.35	20.38	1.68	1.13
DDG1	L	Average	3	2.18	2.84	55.00	3.82	69.74	1.72	0.28
		Standard deviation		0.11	0.04	1.00	0.16	11.12	0.17	0.02
DDG3	R	Average	2	5.86	2.01	37.50	6.33	217.61	15.02	5.15
		Standard deviation		0.37	0.01	2.12	0.03	25.55	1.53	0.65
DDG3	L	Average	3	2.37	2.89	31.00	4.17	66.41	1.86	0.29
		Standard deviation		0.05	0.06	1.00	0.14	10.90	0.23	0.03
DDG4	R	Average	3	6.35	1.98	38.67	7.54	330.45	21.02	5.55
		Standard deviation		0.11	0.03	1.15	0.22	17.13	1.20	0.08
DDG4	L	Average	3	2.19	2.82	45.00	3.72	41.02	1.52	0.54
		Standard deviation		0.15	0.04	8.66	0.42	3.69	0.37	0.52
DDH1	R	Average	3	6.31	1.87	44.00	7.20	252.62	19.81	5.77
		Standard deviation		0.10	0.05	8.72	0.09	6.65	1.39	0.27
DDH1	L	Average	3	1.67	2.60	49.33	2.54	28.02	1.02	0.16
		Standard deviation		0.12	0.10	15.95	0.22	4.99	0.11	0.01
DDH3	R	Average	3	6.56	1.94	44.00	7.45	264.00	20.76	6.62
		Standard deviation		0.42	0.05	8.72	0.44	17.54	0.10	0.37
DDH3	L	Average	3	2.01	2.84	37.00	3.47	45.22	1.37	0.22
		Standard deviation		0.09	0.06	6.08	0.13	6.15	0.04	0.02
DDH5	R	Average	3	7.96	1.84	41.00	8.65	385.81	31.52	8.74
		Standard deviation		0.28	0.03	5.29	0.09	13.40	1.80	0.08
DDH5	L	Average	3	1.60	2.35	28.00	2.12	18.95	0.90	0.21
		Standard deviation		0.04	0.04	7.94	0.05	2.76	0.06	0.01

Table B-7.
Average and standard deviation of selected parameters measured under the muffs of individual subjects
at the 1 meter distance, level 3.

Subject	Ear		N	Peak in		Durations in ms		A-impulse in		Weighted energy in J/m*m		
				kPa		A	B	kPa*ms		Linear	A-WT	P-WT
DDG1	R	Average	2	8.93	1.94	38.00		9.90	508.48	38.81	12.26	
		Standard deviation		0.04	0.02	8.49		0.42	2.35	5.42	3.42	
DDG1	L	Average	2	2.55	2.84	40.00		4.37	69.99	1.91	0.32	
		Standard deviation		0.02	0.06	5.66		0.15	7.50	0.11	0.04	
DDG3	R	Average	2	6.20	2.16	65.00		7.63	316.74	17.61	5.11	
		Standard deviation		0.25	0.03	1.41		0.24	22.03	1.50	0.45	
DDG3	L	Average	2	2.93	3.03	34.50		5.26	86.54	2.25	0.36	
		Standard deviation		0.13	0.01	0.71		0.33	2.52	0.08	0.04	
DDG4	R	Average	2	5.78	2.15	66.00		7.09	363.62	16.99	3.70	
		Standard deviation		0.03	0.05	1.41		0.21	26.97	0.40	0.11	
DDG4	L	Average	2	2.69	2.91	35.00		4.53	75.07	2.24	0.45	
		Standard deviation		0.03	0.02	1.41		0.07	2.96	0.04	0.01	
DDH1	R	Average	3	8.16	1.90	40.00		9.14	445.07	32.03	8.57	
		Standard deviation		0.29	0.03	6.93		0.41	10.26	1.77	0.72	
DDH1	L	Average	3	2.58	3.05	46.00		4.36	68.91	1.89	0.27	
		Standard deviation		0.05	0.18	19.05		0.12	3.47	0.14	0.02	
DDH3	R	Average	3	8.60	1.95	40.33		9.08	454.09	33.94	10.49	
		Standard deviation		0.34	0.04	5.51		0.33	32.54	0.22	0.59	
DDH3	L	Average	2	2.60	2.92	38.00		4.67	87.70	2.91	0.41	
		Standard deviation		0.14	0.03	2.83		0.16	7.40	0.34	0.04	
DDH5	R	Average	2	8.69	1.94	45.00		9.28	545.15	36.52	10.29	
		Standard deviation		0.20	0.04	0.00		0.08	7.98	0.20	0.67	
DDH5	L	Average	3	3.02	2.93	35.00		5.37	86.71	2.51	0.41	
		Standard deviation		0.08	0.06	0.00		0.20	10.44	0.09	0.01	

Table B-8.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 1 meter distance, level 4.

Subject	Ear	N	Peak in kPa		Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
			A	B	A	B		LINEAR	A-WT	P-WT
DDG1	R	Average	2	10.22	1.86	40.00	10.99	647.99	50.44	18.33
		Standard deviation		0.23	0.00	0.00	0.37	38.08	0.53	2.09
DDG1	L	Average	2	4.06	2.86	36.50	6.76	145.06	4.76	0.87
		Standard deviation		0.11	0.05	0.71	0.33	17.95	0.81	0.12
DDG3	R	Average	Lost							
		Standard deviation								
DDG3	L	Average	2	3.84	2.74	37.50	6.36	173.33	4.90	0.82
		Standard deviation		0.06	0.00	0.71	0.12	1.34	0.32	0.05
DDG4	R	Average	2	8.33	2.07	59.50	10.19	626.85	37.02	12.46
		Standard deviation		0.25	0.01	0.71	0.23	6.77	1.84	0.91
DDG4	L	Average	2	4.25	4.20	35.50	8.48	157.16	4.99	0.96
		Standard deviation		0.06	0.15	20.51	0.16	12.82	0.44	0.04

Table B-9.
Average and standard deviation of selected parameters measured under the muffs of individual subjects
at the 1 meter distance, level 5.

Subject	Ear		N	Peak in kPa		Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
				A	B	A	B		Linear	A-WT	P-WT
DDG1	R	Average	2	12.84	2.09	39.50	14.63	880.40	67.13	43.44	
		Standard deviation		0.50	0.00	0.71	0.05	16.14	0.17	2.04	
DDG1	L	Average	2	5.61	3.20	36.00	10.62	404.71	7.66	1.60	
		Standard deviation		0.11	0.04	1.41	0.08	24.79	0.11	0.19	
DDG3	R	Average	2	8.88	2.23	48.50	11.04	592.80	33.13	17.63	
		Standard deviation		1.32	0.07	12.02	1.48	56.21	9.12	2.08	
DDG3	L	Average	2	7.07	3.45	35.00	13.31	378.17	10.58	2.64	
		Standard deviation		0.98	0.18	0.00	1.28	31.26	2.86	1.15	
DDG4	R	Average	2	9.74	2.15	51.00	10.95	631.54	35.99	12.35	
		Standard deviation		0.45	0.06	7.07	0.31	0.23	4.67	2.00	
DDG4	L	Average	2	4.25	2.89	43.50	7.40	215.10	5.39	1.62	
		Standard deviation		0.22	0.21	10.61	0.41	22.80	0.56	0.34	
DDH1	R	Average	2	10.42	2.06	41.00	12.83	677.11	47.51	26.22	
		Standard deviation		1.27	0.06	1.41	0.81	39.76	8.00	6.69	
DDH1	L	Average	2	4.70	2.60	38.50	6.67	186.85	5.24	1.35	
		Standard deviation		0.31	0.08	7.78	0.18	15.68	0.35	0.23	
DDH5	R	Average	2	12.92	2.13	37.00	13.85	771.05	55.75	24.47	
		Standard deviation		0.84	0.06	5.66	0.61	14.51	12.44	4.97	
DDH5	L	Average	2	6.75	3.06	38.00	12.45	477.54	14.29	3.07	
		Standard deviation		0.32	0.17	0.00	0.86	5.28	2.56	0.11	
DDH6	R	Average	2	8.29	2.27	50.00	9.61	528.98	26.26	12.09	
		Standard deviation		1.24	0.17	9.90	0.14	7.99	4.00	2.12	
DDH6	L	Average	2	7.22	2.98	33.00	12.10	390.80	19.91	13.42	
		Standard deviation		0.11	0.21	0.00	1.17	0.87	8.20	14.37	

Table B-10.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 1 meter distance, level 6.

Subject	Ear		N	Peak in ms		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m		
				kPa	A	B			Linear	A-WT	P-WT	
DDG1	R	Average	3	15.57	3.30	36.67	24.34	1670.22	81.14	57.10		
		Standard deviation		0.23	0.15	4.16	1.83	33.97	5.99	5.55		
DDG1	L	Average	3	7.05	3.19	35.00	12.78	809.89	22.94	6.28		
		Standard deviation		0.34	0.25	3.61	0.50	41.20	1.71	0.53		
DDG3	R	Average	Lost									
		Standard deviation										
DDG3	L	Average	3	13.20	3.15	38.67	21.21	1164.94	54.93	30.06		
		Standard deviation		1.15	0.04	4.93	0.90	107.01	2.70	3.76		
DDG4	R	Average	3	12.08	3.00	36.33	19.79	1161.20	56.81	33.58		
		Standard deviation		0.63	0.10	4.93	1.40	55.59	9.88	7.70		
DDG4	L	Average	3	6.79	3.40	39.67	13.84	664.63	16.25	5.67		
		Standard deviation		0.17	0.05	8.08	0.32	36.45	1.70	2.99		
DDH1	R	Average	1	13.00	2.42	42.00	17.29	1271.63	64.59	32.86		
		Standard deviation	NA									
DDH1	L	Average	2	6.09	2.91	42.00	9.31	295.68	8.93	2.19		
		Standard deviation		0.07	0.45	9.90	0.66	36.99	1.26	0.19		
DDH5	R	Average	2	13.63	2.84	36.50	18.72	1103.94	70.16	31.58		
		Standard deviation		1.98	0.04	6.36	2.87	104.96	23.59	13.75		
DDH5	L	Average	2	10.93	3.25	38.50	17.77	866.46	39.02	19.50		
		Standard deviation		3.43	0.13	6.36	2.47	163.52	16.84	13.17		
DDH6	R	Average	2	8.99	3.04	56.50	13.31	879.52	31.03	14.31		
		Standard deviation		1.00	0.04	12.02	2.20	44.65	5.55	3.40		
DDH6	L	Average	2	8.65	3.08	40.00	14.16	955.95	33.00	15.91		
		Standard deviation		0.66	0.04	0.00	0.40	29.47	2.28	10.01		

Table B-11.
 Average and standard deviation of selected parameters measured under the muffs of individual subjects
 at the 1 meter distance, level 7.

Subject	Ear		N	Peak in		Durations in ms		A-impulse in		Weighted energy in J/m*m		
				kPa		A	B	kPa*ms		Linear	A-WT	P-WT
DDG1	R	Average	2	20.04	3.12	32.00		25.40	1709.02	117.14	134.97	
		Standard deviation		3.02	0.08	0.00		2.51	38.88	7.91	41.44	
DDG1	L	Average	2	7.49	3.09	25.50		12.54	848.49	15.45	4.23	
		Standard deviation		1.57	0.09	4.95		1.17	5.75	4.12	2.02	
DDG3	R	Average	1	15.44	4.81	33.00		26.13	1474.97	82.58	70.96	
		Standard deviation	NA									
DDG3	L	Average	1	7.03	3.46	45.00		12.49	529.43	18.46	6.05	
		Standard deviation	NA									
DDG4	R	Average	2	13.36	3.39	33.00		24.67	1593.48	62.48	33.56	
		Standard deviation		2.25	0.08	0.00		4.85	179.95	16.07	8.72	
DDG4	L	Average	1	7.22	3.85	33.00		14.24	927.05	24.67	6.54	
		Standard deviation	NA									
DDH1	R	Average	3	17.22	3.97	32.33		27.77	1738.80	104.62	87.96	
		Standard deviation		0.37	0.73	0.58		1.82	79.42	5.26	3.14	
DDH1	L	Average	3	7.85	3.09	37.00		14.30	503.52	14.39	5.54	
		Standard deviation		0.04	0.11	1.00		0.40	56.56	1.91	3.57	
DDH5	R	Average	1	13.79	3.79	33.00		22.47	1457.61	57.51	29.94	
		Standard deviation	NA									
DDH5	L	Average	3	7.30	2.68	35.00		11.05	797.21	21.60	4.92	
		Standard deviation		0.46	0.12	0.00		0.56	22.40	3.07	0.57	
DDH6	R	Average	3	11.93	3.51	33.00		22.65	1378.05	52.53	32.50	
		Standard deviation		0.28	0.11	0.00		1.19	85.98	3.92	1.51	
DDH6	L	Average	Lost									

Table B-12.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 1.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
DDG1	R	Average	3	169.66	44.33	226.33	143.71	132.60
		Standard deviation		0.00	9.24	54.56	0.10	0.38
DDG1	L	Average	3	157.97	56.00	34767.48	134.58	119.07
		Standard deviation		0.18	0.00	2748.13	0.39	0.37
DDG3	R	Average	3	167.71	40.00	614.55	141.85	130.28
		Standard deviation		0.27	0.00	77.62	0.12	0.17
DDG3	L	Average	3	158.72	46.00	33071.96	135.26	118.75
		Standard deviation		0.12	8.66	8241.18	0.24	0.24
DDG5	R	Average	3	167.30	53.00	510.42	143.02	130.28
		Standard deviation		0.30	4.36	34.63	0.09	0.08
DDG5	L	Average	3	157.75	42.00	56966.49	132.60	119.08
		Standard deviation		0.20	2.65	9497.94	0.09	0.12
DDH1	R	Average	3	169.96	39.00	225.05	143.17	132.57
		Standard deviation		0.26	0.00	27.56	0.05	0.49
DDH1	L	Average	3	156.28	57.67	77973.37	132.03	117.16
		Standard deviation		0.37	17.01	23787.39	0.46	0.32
DDH3	R	Average	3	170.12	39.00	209.86	142.74	132.07
		Standard deviation		0.42	1.00	33.07	0.14	0.19
DDH3	L	Average	3	158.97	58.33	20925.13	134.87	119.19
		Standard deviation		0.59	7.77	2190.29	0.35	0.58
DDH5	R	Average	3	170.48	42.33	159.43	144.35	133.01
		Standard deviation		0.39	4.04	12.34	0.16	0.29
DDH5	L	Average	3	157.23	56.33	48515.94	133.18	117.71
		Standard deviation		0.12	1.15	2121.26	0.05	0.27

Table B-13.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 2.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
DDG1	R	Average Standard deviation	3 0.27	171.35 0.27	38.00 1.00	123.71 19.12	145.59 0.26	129.27 0.61
DDG1	L	Average Standard deviation	3 0.44	160.73 0.44	55.00 1.00	10096.09 1945.46	138.58 0.72	122.51 0.43
DDG3	R	Average Standard deviation	2 0.56	169.32 0.56	37.50 2.12	320.08 57.63	143.54 0.51	131.93 0.44
DDG3	L	Average Standard deviation	3 0.17	161.47 0.17	31.00 1.00	15191.14 1121.85	138.37 0.69	122.85 0.52
DDG4	R	Average Standard deviation	3 0.15	170.04 0.15	38.67 1.15	218.99 7.78	145.37 0.22	133.40 0.25
DDG4	L	Average Standard deviation	3 0.60	160.79 0.60	45.00 8.66	13384.80 4806.04	136.30 0.40	121.92 1.02
DDH1	R	Average Standard deviation	3 0.13	169.98 0.13	44.00 8.72	198.54 56.25	144.20 0.11	133.14 0.30
DDH1	L	Average Standard deviation	3 0.60	158.44 0.60	49.33 15.95	38918.35 21196.30	134.61 0.82	120.25 0.50
DDH3	R	Average Standard deviation	3 0.55	170.31 0.55	44.00 8.72	168.63 40.13	144.39 0.29	133.35 0.02
DDH3	L	Average Standard deviation	3 0.40	160.04 0.40	37.00 6.08	23725.38 3743.96	136.71 0.59	121.56 0.11
DDH5	R	Average Standard deviation	3 0.30	172.00 0.30	41.00 5.29	85.04 24.36	146.04 0.15	135.16 0.25
DDH5	L	Average Standard deviation	3 0.22	158.06 0.22	28.00 7.94	92385.66 41068.92	132.92 0.66	119.73 0.26

Table B-14.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 3.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	MIL-STD-1474	ANR	Weighted SEL in dB SPL		
								Linear	A-WT	P-WT
DDG1	R	Average	2	172.99	38.00		59.91	147.24	136.05	130.98
		Standard deviation		0.03	8.49		18.56	0.02	0.61	1.23
DDG1	L	Average	2	162.09	40.00		8276.52	138.62	122.98	115.21
		Standard deviation		0.07	5.66		1820.66	0.47	0.24	0.58
DDG3	R	Average	2	169.82	65.00		121.78	145.18	132.63	127.25
		Standard deviation		0.36	1.41		16.44	0.30	0.37	0.38
DDG3	L	Average	2	163.31	34.50		5667.65	139.55	123.69	115.67
		Standard deviation		0.38	0.71		827.88	0.13	0.15	0.43
DDC4	R	Average	2	169.22	66.00		157.00	145.78	132.48	125.86
		Standard deviation		0.04	1.41		1.39	0.32	0.10	0.13
DDC4	L	Average	2	162.57	35.00		7774.18	138.93	123.67	116.66
		Standard deviation		0.09	1.41		90.29	0.17	0.07	0.07
DDH1	R	Average	3	172.21	40.00		79.12	146.66	135.23	129.50
		Standard deviation		0.31	6.93		15.51	0.10	0.24	0.37
DDH1	L	Average	3	162.20	46.00		7512.65	138.56	122.93	114.54
		Standard deviation		0.17	19.05		3380.11	0.22	0.32	0.34
DDH3	R	Average	3	172.66	40.33		64.34	146.74	135.49	130.38
		Standard deviation		0.34	5.51		20.63	0.31	0.03	0.24
DDH3	L	Average	2	162.27	38.00		8047.42	139.60	124.80	116.25
		Standard deviation		0.47	2.83		953.32	0.37	0.51	0.38
DDH5	R	Average	2	172.76	45.00		51.22	147.55	135.81	130.30
		Standard deviation		0.20	0.00		4.66	0.06	0.02	0.28
DDH5	L	Average	3	163.57	35.00		4933.20	139.54	124.18	116.31
		Standard deviation		0.22	0.00		511.30	0.53	0.15	0.11

Table B-15.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 4.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	MIL-STD-1474	ANR	Weighted SEL in dB SPL		
								Linear	A-WT	P-WT
DDG1	R	Average	2	174.17	40.00	31.30	148.29	137.21	132.80	
		Standard deviation		0.19	0.00	2.77	0.26	0.05	0.50	
DDG1	L	Average	2	166.14	36.50	1430.19	141.78	126.93	119.53	
		Standard deviation		0.23	0.71	185.92	0.54	0.74	0.61	
DDG3	R	Average		Lost						
		Standard deviation								
DDG3	L	Average	2	165.67	37.50	1708.12	142.57	127.07	119.29	
		Standard deviation		0.13	0.71	57.87	0.03	0.28	0.26	
DDG4	R	Average	2	172.39	59.50	41.92	148.15	135.86	131.13	
		Standard deviation		0.27	0.71	4.45	0.05	0.22	0.32	
DDG4	L	Average	2	166.54	35.50	1590.40	142.14	127.15	120.00	
		Standard deviation		0.13	20.51	1097.91	0.35	0.38	0.19	

Table B-16.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 5.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	MIL-STD-1474 ANR	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
DDG1	R	Average	2	176.14	39.50	12.84	149.63	138.45
		Standard deviation		0.34	0.71	1.70	0.08	0.01
DDG1	L	Average	2	168.96	36.00	39.72	146.25	129.02
		Standard deviation		0.18	1.41	52.68	0.27	0.06
DDG3	R	Average	2	172.90	48.50	45.04	147.90	135.30
		Standard deviation		1.29	12.02	11.67	0.41	1.21
DDG3	L	Average	2	170.92	35.00	179.62	145.95	130.34
		Standard deviation		1.21	0.00	95.38	0.36	1.19
DDG4	R	Average	2	173.74	51.00	28.65	148.18	135.72
		Standard deviation		0.40	7.07	10.31	0.00	0.57
DDG4	L	Average	2	166.53	43.50	963.60	143.49	127.48
		Standard deviation		0.45	10.61	115.77	0.46	0.45
DDH1	R	Average	2	174.30	41.00	29.85	148.48	136.92
		Standard deviation		1.06	1.41	12.77	0.26	0.73
DDH1	L	Average	2	167.41	38.50	802.11	142.89	127.37
		Standard deviation		0.58	7.78	409.85	0.36	0.29
DDH5	R	Average	2	176.19	37.00	13.76	149.05	137.59
		Standard deviation		0.57	5.66	0.78	0.08	0.98
DDH5	L	Average	2	170.55	38.00	178.17	146.97	131.70
		Standard deviation		0.41	0.00	33.43	0.05	0.78
DDH6	R	Average	2	172.30	50.00	66.38	147.41	134.35
		Standard deviation		1.31	9.90	51.30	0.07	0.66
DDH6	L	Average	2	171.15	33.00	162.06	146.10	132.98
		Standard deviation		0.14	0.00	10.15	0.01	1.84

Table B-17.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 6.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
							Linear	A-WT	P-WT
DDG1	R	Average	3	177.83	36.67	6.57	152.41	139.27	137.73
		Standard deviation		0.13	4.16	0.70	0.09	0.32	0.43
DDG1	L	Average	3	170.94	35.00	166.62	149.26	133.78	128.15
		Standard deviation		0.41	3.61	18.64	0.22	0.32	0.36
DDG3	R	Average	3	176.37	38.67	12.81	150.83	137.58	134.94
		Standard deviation		0.74	4.93	5.57	0.41	0.21	0.55
DDG3	L	Average	Lost						
		Standard deviation							
DDG4	R	Average	3	175.61	36.33	19.22	150.83	137.68	135.36
		Standard deviation		0.45	4.93	6.34	0.21	0.75	1.06
DDG4	L	Average	3	170.61	39.67	166.71	148.40	132.27	127.35
		Standard deviation		0.22	8.08	25.16	0.24	0.45	2.12
DDH1	R	Average	1	176.26	42.00	11.18	151.22	138.28	135.35
		Standard deviation	NA						
DDH1	L	Average	2	169.67	42.00	240.86	144.87	129.67	123.57
		Standard deviation		0.10	9.90	64.14	0.54	0.61	0.38
DDH5	R	Average	2	176.62	36.50	11.86	150.60	138.52	134.96
		Standard deviation		1.27	6.36	4.07	0.41	1.49	1.95
DDH5	L	Average	2	174.53	38.50	36.30	149.52	135.88	132.52
		Standard deviation		2.77	6.36	32.51	0.82	1.94	3.19
DDH6	R	Average	2	173.02	56.50	34.19	149.62	135.06	131.67
		Standard deviation		0.97	12.02	5.45	0.22	0.78	1.04
DDH6	L	Average	2	172.71	40.00	62.67	149.98	135.36	131.72
		Standard deviation		0.67	0.00	18.98	0.13	0.30	2.94

Table B-18.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 1 meter distance, level 7.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	MIL-STD-1474 ANR	Weighted SEL in dB SPL		
							LINEAR	A-WT	P-WT
DDG1	R	Average	2	179.97	32.00	3.18	152.51	140.86	141.38
		Standard deviation		1.31	0.00	1.81	0.10	0.29	1.35
DDG1	L	Average	2	171.37	25.50	226.47	149.47	131.99	126.18
		Standard deviation		1.83	4.95	125.44	0.03	1.17	2.16
DDG3	R	Average	1	177.75	33.00	7.74	151.87	139.35	138.69
		Standard deviation	NA						
DDG3	L	Average	1	170.92	45.00	119.29	147.42	132.84	128.00
		Standard deviation	NA						
DDG4	R	Average	2	176.43	33.00	15.86	152.19	138.07	135.36
		Standard deviation		1.47	0.00	9.98	0.49	1.13	1.14
DDG4	L	Average	1	171.15	33.00	161.86	149.85	134.10	128.34
		Standard deviation	NA						
DDH1	R	Average	3	178.70	32.33	5.16	152.58	140.37	139.62
		Standard deviation		0.19	0.58	0.37	0.20	0.22	0.15
DDH1	L	Average	3	171.88	37.00	99.44	147.18	131.73	127.06
		Standard deviation		0.04	1.00	4.68	0.49	0.59	2.61
DDH5	R	Average	1	176.77	33.00	12.16	151.82	137.78	134.94
		Standard deviation	NA						
DDH5	L	Average	3	171.23	35.00	147.23	149.20	133.50	127.08
		Standard deviation		0.54	0.00	35.80	0.12	0.62	0.52
DDH6	R	Average	3	175.51	33.00	21.81	151.57	137.38	135.30
		Standard deviation		0.20	0.00	1.96	0.27	0.32	0.20
DDH6	L	Average	Lost						

Appendix C.

Pressure-time signatures and summary data tables for the 3 meter exposure distance.

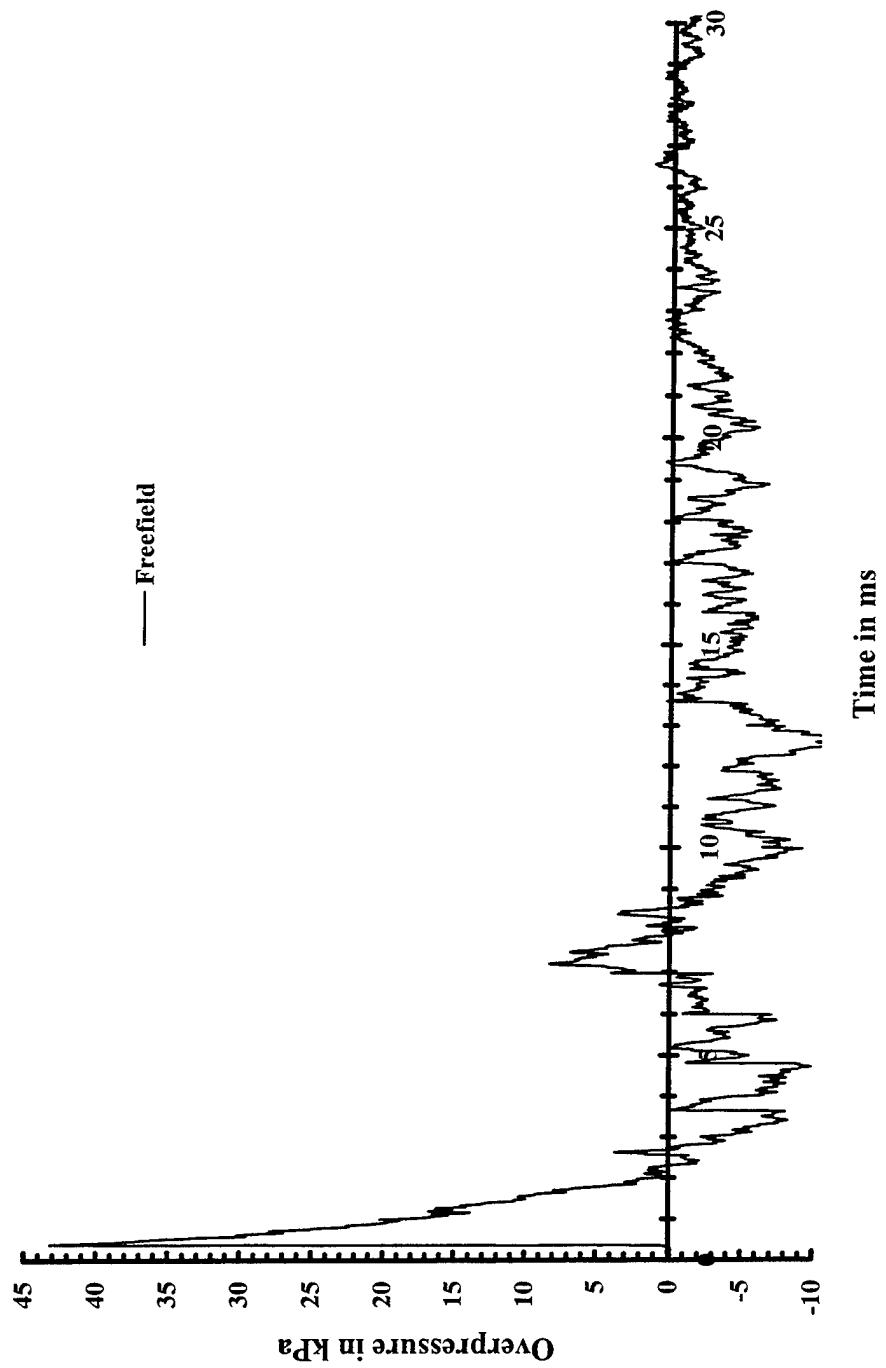


Figure C-1. Pressure-time signature measured in the freefield at the 3 meter distance.

C-2

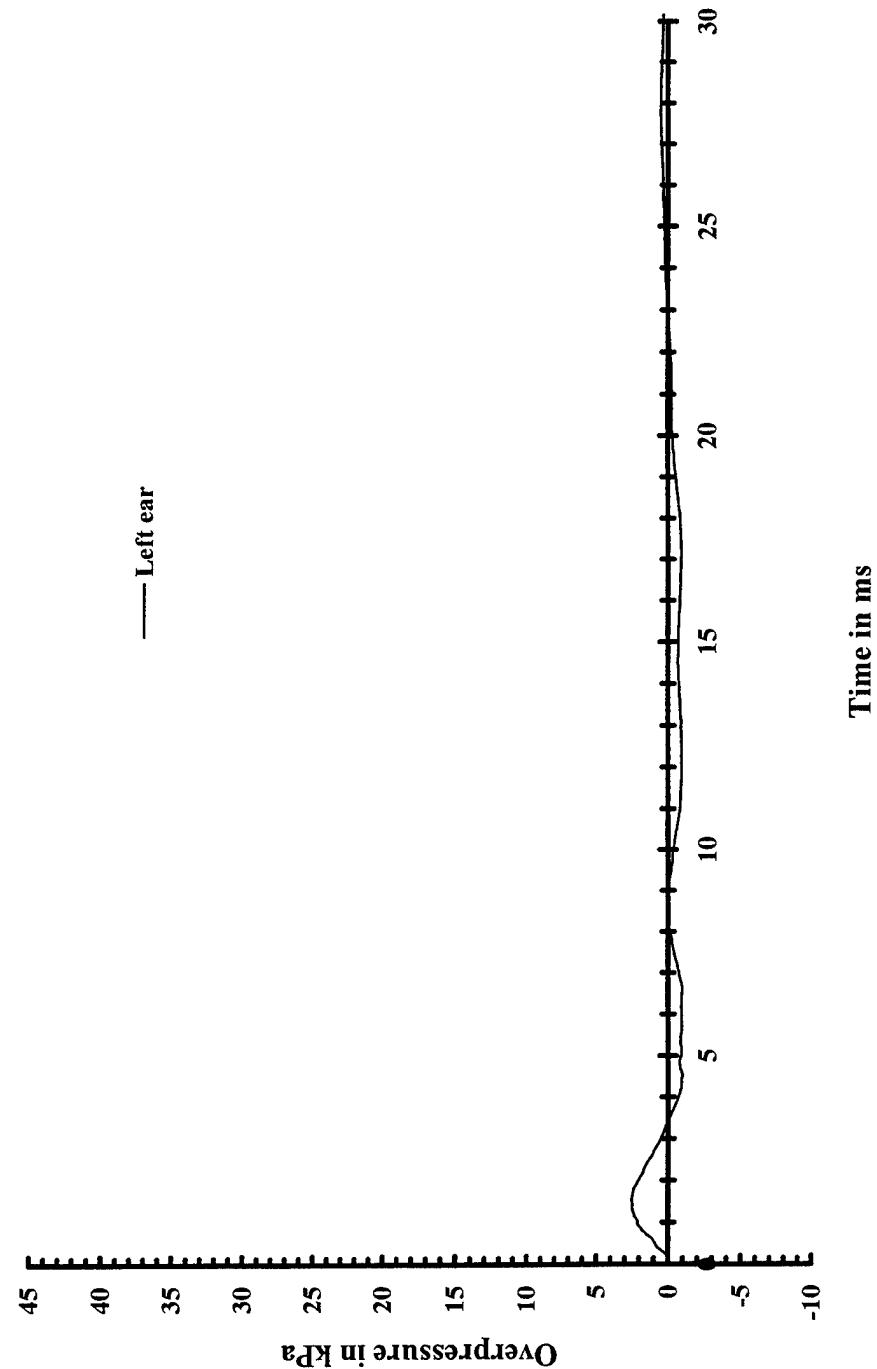


Figure C-2. Pressure-time signature measured under the right earmuff at the 3 meter distance.

C-3

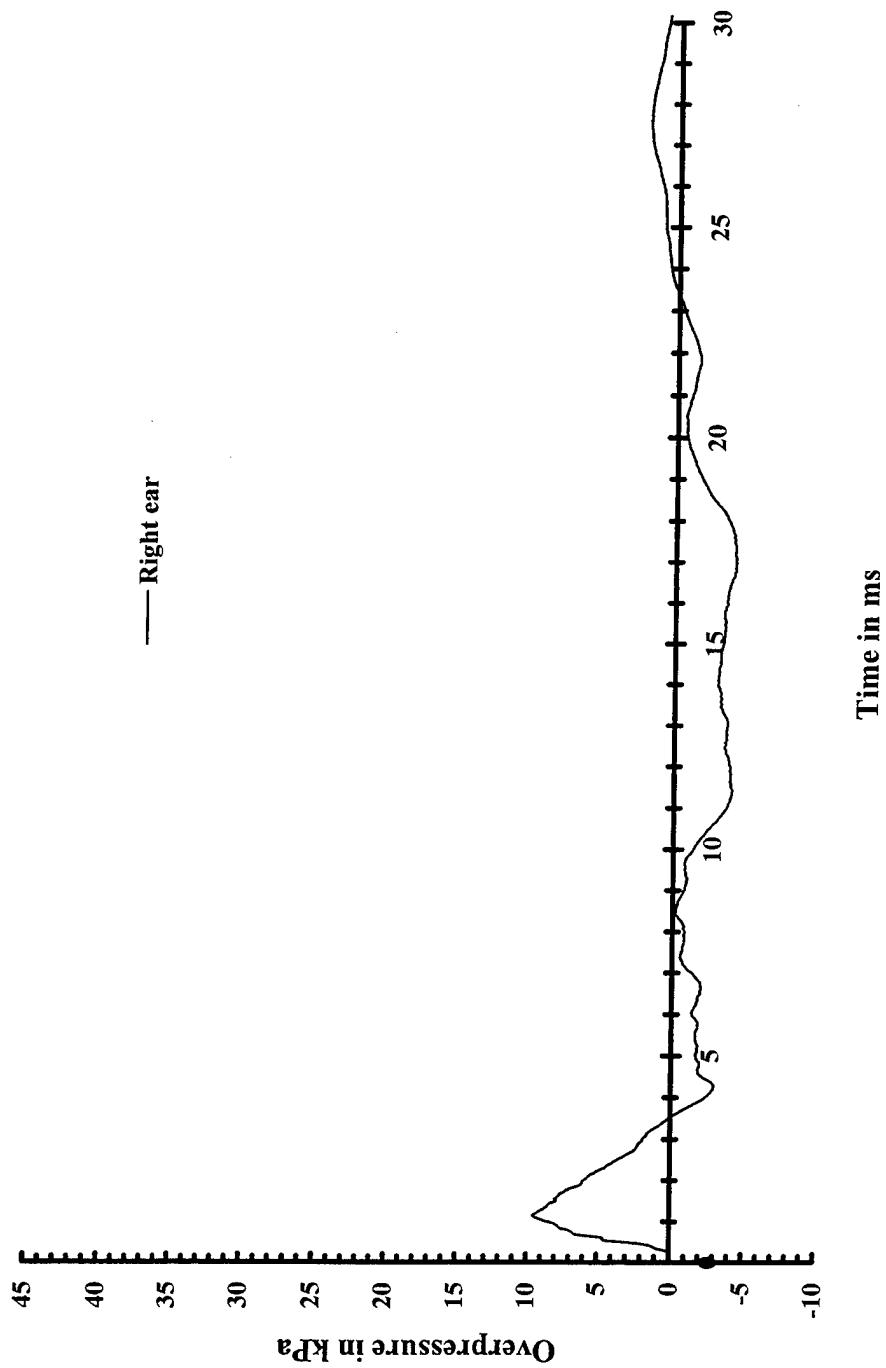


Figure C-3. Pressure-time signature measured under the left earmuff at the 3 meter distance.

C-4

Table C-1.
Average and standard deviation of selected parameters measured outside the earmuffs at the 3 meter distance.

Level	N	Peak in kPa	Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m		
			A	B	Linear	A-WT	P-WT		
Lost									
1									
2	Average	12	15.79	1.44	23.42	9.67	378.71	134.79	144.24
	Standard deviation		0.59	0.10	9.25	0.17	27.31	26.18	24.56
3	Average	12	22.09	1.53	25.50	14.14	758.05	275.88	303.29
	Standard deviation		1.28	0.09	8.08	0.27	99.21	65.44	67.04
4	Average	25	34.77	1.49	23.64	20.52	1661.81	609.46	660.28
	Standard deviation		1.36	0.07	8.05	0.64	168.68	146.74	131.99
5	Average	28	44.66	1.70	21.61	29.36	3251.16	828.86	941.59
	Standard deviation		1.38	0.09	5.76	1.43	234.84	198.43	218.27
6	Average	24	65.40	1.54	21.83	33.95	6432.84	1708.44	2026.40
	Standard deviation		2.80	0.14	4.06	1.66	473.89	380.99	413.73
7	Average	6	91.72	1.41	38.50	45.31	16309.15	3295.11	3844.49
	Standard deviation		5.50	0.08	2.81	1.41	606.82	138.52	172.84

Table C-2.
Average and standard deviation of selected parameters in dB measured outside the earmuffs at the 3 meter distance.

Level	N	Peak in dB SPL	B-duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
					Linear	A-WT	P-WT
1	Lost						
2	Average	12	177.94	23.42	14.25	145.95	141.40
	Standard deviation		0.32	9.25	7.54	0.32	0.85
3	Average	12	180.85	25.50	3.31	148.94	144.48
	Standard deviation		0.50	8.08	1.90	0.56	1.04
4	Average	25	184.80	23.64	0.52	152.37	147.92
	Standard deviation		0.34	8.05	0.15	0.43	0.98
5	Average	28	186.97	21.61	0.21	155.29	149.26
	Standard deviation		0.27	5.76	0.05	0.30	0.92
6	Average	24	190.28	21.83	0.04	158.25	152.41
	Standard deviation			4.06	0.01	0.32	0.95
7	Average	6	193.22	0.37	0.01	162.30	155.36
	Standard deviation		0.52	2.81	0.00	0.16	0.18

Table C-3.
Between subject average and standard deviation of selected parameters measured under the muffs at the 3 meter distance.

Level	Ear	R	Average	Standard deviation	N kPa	A kPa	B kPa	Peak in ms		Durations in ms		A-impulse in J/m*m		Weighted energy in J/m*m	
								Lost	Lost	A	B	kPa*ms	Linear	A-WT	P-WT
1															
2	R	Average	5	4.11	2.48	46.00	6.25	124.19	7.59	1.93					
		Standard deviation		1.15	0.10	4.96	1.51	58.89	4.08	1.07					
L	Average	3	1.32	2.92	54.11	2.24	14.74	0.50	0.11						
	Standard deviation		0.14	0.25	10.12	0.43	5.59	0.08	0.03						
3	R	Average	6	6.56	2.52	42.44	10.19	340.66	20.14	5.63					
	Standard deviation		3.52	0.10	6.17	5.90	403.03	23.00	5.89						
L	Average	5	2.00	3.02	46.40	3.60	36.46	1.17	0.24						
	Standard deviation		0.75	0.20	11.21	1.53	26.86	0.72	0.05						
4	R	Average	6	7.80	2.76	45.40	12.35	404.74	23.57	8.82					
	Standard deviation		2.24	0.20	6.71	2.60	172.31	14.22	6.43						
L	Average	2	1.93	3.00	50.30	3.41	34.91	0.86	0.16						
	Standard deviation		0.52	0.08	1.70	1.04	22.71	0.48	0.07						
5	R	Average	4	11.04	3.17	43.85	18.33	699.47	35.42	14.83					
	Standard deviation		1.61	0.16	5.95	2.04	170.87	15.20	9.00						
L	Average	3	4.27	3.72	43.63	9.61	164.86	4.22	1.04						
	Standard deviation		1.66	0.33	15.49	4.49	105.37	3.12	0.91						
6	R	Average	7	12.57	3.30	38.80	21.36	966.55	49.88	22.16					
	Standard deviation		2.89	0.18	5.48	4.39	356.61	22.53	12.73						
L	Average	7	4.74	3.29	33.96	9.18	241.73	6.52	1.55						
	Standard deviation		1.33	0.28	5.98	3.03	151.00	4.65	1.27						
7	R	Average	5	14.08	3.85	37.20	26.56	1287.71	53.90	22.18					
	Standard deviation		3.81	0.14	17.29	6.42	610.81	27.51	11.00						
L	Average	5	6.24	3.31	32.90	11.30	342.56	10.41	2.68						
	Standard deviation		2.12	0.26	13.37	4.11	151.02	6.45	1.92						

Table C-4.

Between subject average and standard deviation of selected parameters in dB measured under the muffs at the 3 meter distance.

Level	Ear		N	Peak in dB SPL	B-duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
							Average	Standard deviation	Linear
1	R	Average	5	165.96	46.00	1853.28	140.64	128.34	122.32
		Standard deviation		2.58	4.96	1952.83	2.38	2.79	2.93
1	L	Average	Lost	Lost					
2	R	Average	3	156.35	54.11	96663.97	131.67	117.10	110.44
		Standard deviation		0.87	10.12	33542.40	1.53	0.76	1.05
3	R	Average	6	169.42	42.44	778.78	143.51	131.33	125.94
		Standard deviation		4.17	6.17	952.61	4.35	4.23	4.15
3	L	Average	5	159.50	46.40	44341.60	134.87	120.21	113.84
		Standard deviation		3.25	11.21	44411.13	3.14	2.65	0.99
4	R	Average	6	171.48	45.40	175.58	145.81	133.07	128.39
		Standard deviation		2.56	6.71	205.61	2.25	2.99	3.74
4	L	Average	2	159.53	50.30	26882.08	135.08	119.18	112.10
		Standard deviation		2.35	1.70	21463.74	3.03	2.54	1.86
5	R	Average	4	174.77	43.85	24.27	148.53	135.36	131.14
		Standard deviation		1.27	5.95	12.79	1.07	1.91	3.01
5	L	Average	3	166.11	43.63	1994.27	141.59	125.45	118.99
		Standard deviation		3.67	15.49	2220.94	3.34	3.76	4.35
6	R	Average	7	175.60	38.80	36.79	149.55	136.43	132.69
		Standard deviation		2.15	5.48	51.50	2.00	2.30	2.64
6	L	Average	7	167.18	33.96	1831.23	143.21	127.46	120.95
		Standard deviation		2.44	5.98	1829.12	2.92	2.83	3.18
7	R	Average	5	176.65	37.20	15.68	150.83	136.92	133.17
		Standard deviation		2.63	17.29	12.20	2.30	2.66	2.26
7	L	Average	5	169.46	32.90	554.74	145.08	129.54	123.40
		Standard deviation		3.02	13.37	429.79	2.32	3.02	3.45

Table C-5.

There were no data available for level 1 at the 3 meter distance.

Table C-6.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 3 meter distance, level 2.

Subject	Ear		N	Peak in kPa	Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m	
					A	B	Linear	A-WT	P-WT	
CEH2	R	Average	3	4.19	2.42	47.67	6.37	131.71	7.29	1.88
		Standard deviation		0.08	0.02	6.35	0.16	4.28	0.23	0.08
CEH2	L	Average	2	1.48	3.19	65.00	2.74	21.19	0.53	0.10
		Standard deviation		0.06	0.01	50.91	0.11	1.97	0.07	0.01
CEH3	R	Average	3	4.87	2.41	43.33	7.20	164.06	10.74	2.84
		Standard deviation		0.07	0.02	1.53	0.11	4.52	0.63	0.24
CEH3	L	Average	3	1.25	2.88	52.33	1.97	11.60	0.40	0.09
		Standard deviation		0.03	0.09	9.24	0.09	0.77	0.01	0.00
CEH4	R	Average	3	2.62	2.65	54.00	4.22	51.69	2.56	0.66
		Standard deviation		0.21	0.03	8.66	0.29	6.79	0.38	0.26
CEH4	L	Average	1	1.23	2.70	45.00	2.02	11.42	0.56	0.14
		Standard deviation	NA							
CEI3	R	Average	3	5.51	2.42	42.67	8.08	194.42	12.46	3.15
		Standard deviation		0.13	0.02	0.58	0.25	11.59	0.67	0.17
CEI3	L	Average	Lost							
		Standard deviation	Lost							
CEI4	R	Average	3	3.36	2.52	42.33	5.37	79.07	4.87	1.11
		Standard deviation		0.04	0.02	1.15	0.15	5.09	0.19	0.03
CEI4	L	Average	Lost							
		Standard deviation	Lost							

Table C-7.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 3 meter distance, level 3.

Subject	Ear		N	Peak in kPa		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m		
				A	B	A	B	Linear	A-WT	P-WT		
CEH2	R	Average	3	13.12	2.51	43.00	21.46	1140.32	65.48	17.07		
		Standard deviation		0.02	0.01	5.20	0.11	44.33	1.00	1.27		
CEH2	L	Average	3	3.09	3.16	39.33	5.73	78.68	2.32	0.33		
		Standard deviation		0.16	0.03	16.20	0.41	6.90	0.24	0.01		
CEH3	R	Average	3	3.41	2.45	42.67	4.78	66.45	4.38	1.41		
		Standard deviation		0.10	0.02	6.81	0.10	2.73	0.32	0.15		
CEH3	L	Average	3	1.34	3.05	50.33	2.26	15.98	0.53	0.22		
		Standard deviation		0.05	0.31	4.04	0.09	1.69	0.04	0.09		
CEH4	R	Average	3	5.39	2.50	34.67	7.90	153.28	10.31	4.80		
		Standard deviation		0.23	0.06	5.03	0.10	5.16	1.00	1.00		
CEH4	L	Average	1	1.26	2.75	49.00	2.07	14.23	0.58	0.25		
		Standard deviation	NA									
CEI2	R	Average	3	6.03	2.61	52.67	9.71	269.09	14.05	3.19		
		Standard deviation		0.48	0.09	7.57	0.29	25.88	2.36	0.74		
CEI2	L	Average	3	2.04	2.89	32.00	3.54	26.96	1.14	0.18		
		Standard deviation		0.17	0.06	1.73	0.34	4.66	0.19	0.02		
CEI3	R	Average	3	7.44	2.40	44.00	10.61	311.80	20.83	5.93		
		Standard deviation		0.11	0.02	1.73	0.18	9.02	1.21	0.42		
CEI3	L	Average		Lost								
		Standard deviation										
CEI4	R	Average	3	3.99	2.68	37.67	6.69	103.03	5.79	1.37		
		Standard deviation		0.08	0.03	7.09	0.05	1.49	0.22	0.02		
CEI4	L	Average	3	2.26	3.25	61.33	4.42	46.46	1.30	0.23		
		Standard deviation		0.06	0.04	3.21	0.14	1.28	0.06	0.01		

Table C-8.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 3 meter distance, level 4.

Subject	Ear		N	Peak in kPa		Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
				A	B	A	B		Linear	A-WT	P-WT
CEH2	R	Average	11	8.17	2.52	49.73	13.20	476.19	26.13	11.26	
		Standard deviation		0.21	0.05	7.23	0.55	23.51	1.84	0.76	
CEH2	L	Average	11	2.30	3.06	49.09	4.15	50.97	1.20	0.21	
		Standard deviation		0.09	0.09	25.99	0.10	6.23	0.11	0.02	
CEH3	R	Average	3	9.27	2.60	44.67	14.49	537.79	34.60	12.59	
		Standard deviation		0.12	0.08	0.58	0.23	25.56	0.51	0.71	
CEH3	L	Average	Lost								
		Standard deviation									
CEH4	R	Average	3	5.78	2.82	41.00	9.60	207.69	10.97	3.36	
		Standard deviation		0.90	0.14	1.00	0.80	30.01	3.19	0.72	
CEH4	L	Average	Lost								
		Standard deviation									
CEI2	R	Average	2	7.53	3.00	56.50	12.97	446.31	18.15	5.13	
		Standard deviation		0.23	0.09	0.71	0.07	16.35	1.39	0.42	
CEI2	L	Average	2	1.57	2.95	51.50	2.68	18.85	0.53	0.12	
		Standard deviation		0.05	0.05	7.78	0.02	0.01	0.02	0.01	
CEI3	R	Average	2	11.07	2.64	38.00	15.11	585.06	44.30	18.65	
		Standard deviation		2.57	0.03	9.90	2.06	102.82	17.23	7.59	
CEI3	L	Average	Lost								
		Standard deviation									
CEI4	R	Average	2	4.99	2.97	42.50	8.74	175.44	7.28	1.97	
		Standard deviation		0.39	0.06	0.71	0.26	6.14	0.56	0.25	
CEI4	L	Average	Lost								
		Standard deviation									

Table C-9.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 3 meter distance, level 5.

Subject	Ear		N	Peak in kPa	Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
					A	B		Linear	A-WT	P-WT
CEH2	R	Average	10	11.88	3.09	42.90	19.23	770.45	41.01	22.31
		Standard deviation		0.56	0.05	0.57	0.75	34.20	3.20	4.45
CEH2	L	Average	10	4.40	3.93	35.40	10.06	164.09	3.77	0.79
		Standard deviation		0.17	0.19	6.04	0.26	9.91	0.41	0.13
CEI2	R	Average	2	9.32	3.27	51.50	15.55	602.54	20.19	5.76
		Standard deviation		0.49	0.03	10.61	0.82	26.81	1.35	0.08
CEI2	L	Average	2	2.56	3.34	61.50	4.91	59.89	1.35	0.28
		Standard deviation		0.04	0.01	0.71	0.16	5.55	0.03	0.01
CEI3	R	Average	2	12.85	2.98	44.00	20.30	903.27	54.09	22.82
		Standard deviation		0.04	0.22	1.41	0.34	0.77	0.31	1.68
CEI3	L	Average	Lost							
		Standard deviation								
CEI4	R	Average	2	10.13	3.33	37.00	18.22	521.65	26.40	8.43
		Standard deviation		0.13	0.12	7.07	0.44	20.19	1.30	1.15
CEI4	L	Average	1	5.87	3.89	34.00	13.85	270.62	7.55	2.04
		Standard deviation		NA						

Table C-10.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 3 meter distance, level 6.

Subject	Ear	N	Peak in kPa	Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m	
				A	B	Linear	A-WT	P-WT	
CEH1	R	Average	6	13.01	3.54	38.67	23.66	1177.61	47.65
		Standard deviation		1.58	0.33	5.16	2.11	165.62	11.75
CEH1	L	Average	5	4.74	3.55	36.80	9.55	300.25	6.60
		Standard deviation		0.55	0.12	16.90	2.05	27.96	0.91
CEH3	R	Average	9	9.03	3.17	43.78	15.24	598.93	31.51
		Standard deviation		4.55	0.10	7.14	6.70	503.25	30.17
CEH3	L	Average	3	4.30	3.02	27.33	7.32	168.79	4.45
		Standard deviation		0.10	0.04	0.58	0.27	21.81	0.45
CEH4	R	Average	6	12.00	3.19	33.67	19.46	686.78	42.00
		Standard deviation		0.45	0.12	4.08	0.46	33.68	5.86
CEH4	L	Average	8	3.16	2.81	36.75	5.13	64.99	2.43
		Standard deviation		0.47	0.35	15.20	1.28	14.84	0.30
CEH5	R	Average	3	11.53	3.39	47.67	21.77	1064.71	46.42
		Standard deviation		0.79	0.53	8.96	1.70	59.17	1.28
CEH5	L	Average	3	3.38	3.22	31.00	6.49	133.79	2.64
		Standard deviation		0.11	0.05	4.36	0.22	12.12	0.19
CEI2	R	Average	2	16.76	3.27	32.50	27.72	1369.66	80.48
		Standard deviation		5.42	0.11	0.71	2.74	217.35	44.78
CEI2	L	Average	3	4.90	3.50	42.33	10.61	211.90	5.66
		Standard deviation		0.81	0.29	5.51	2.70	47.09	2.06
CEI3	R	Average	3	15.85	3.06	35.67	24.59	1340.78	79.66
		Standard deviation		0.70	0.12	5.51	0.32	83.46	5.23
CEI3	L	Average	2	5.75	3.50	26.00	11.41	283.32	7.85
		Standard deviation		0.21	0.06	8.49	0.75	24.52	0.60

Table C-11.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 3 meter distance, level 7.

Subject	Ear		N	Peak in ms		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m	
				kPa	A	B	Linear	A-WT	P-WT		
CEH1	R	Average	2	16.21	3.82	32.00	28.05	1789.19	69.32	24.67	
		Standard deviation		0.46	1.03	2.83	0.93	130.10	5.08	3.13	
CEH1	L	Average	2	9.11	3.72	23.50	17.49	510.18	19.27	5.07	
		Standard deviation		0.76	0.25	4.95	0.92	49.19	5.05	1.36	
CEH3	R	Average	1	8.41	4.06	68.00	16.74	537.27	18.42	9.44	
		Standard deviation	NA								
CEH3	L	Average	2	6.16	3.05	29.00	10.27	368.31	10.11	2.05	
		Standard deviation		0.33	0.24	11.31	1.27	51.52	1.52	0.13	
CEH4	R	Average	3	15.10	3.72	28.00	26.62	1100.90	53.53	21.93	
		Standard deviation		0.96	0.04	0.00	1.23	24.26	4.09	2.55	
CEH4	L	Average	1	3.89	3.18	55.00	7.23	135.25	3.68	1.07	
		Standard deviation	NA								
CEI2	R	Average	Lost								
		Standard deviation									
CEI2	L	Average	2	4.58	3.18	35.00	8.40	251.05	4.97	0.87	
		Standard deviation		0.61	0.08	18.38	1.44	43.27	1.34	0.13	
CEI3	R	Average	2	18.27	3.75	29.50	34.70	2028.98	89.82	38.84	
		Standard deviation		0.88	0.09	2.12	1.88	144.14	6.41	8.74	
CEI3	L	Average	2	7.46	3.42	22.00	13.10	448.02	14.03	4.37	
		Standard deviation		0.03	0.08	0.00	0.18	37.37	0.94	0.52	
CEI4	R	Average	2	12.43	3.89	28.50	26.71	982.21	38.41	16.04	
		Standard deviation		0.43	0.30	0.71	1.52	69.08	2.06	1.78	
CEI4	L	Average	Lost								
		Standard deviation									

Table C-12.

There were no data available for level 1 at the 3 meter distance.

Table C-13.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 3 meter distance, level 2.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
							Linear	A-WT	P-WT
CEH2	R	Average	3	166.42	47.67	886.36	141.38	128.81	122.92
		Standard deviation		0.17	6.35	96.93	0.14	0.14	0.17
CEH2	L	Average	2	157.35	65.00	60818.64	133.43	117.40	109.95
		Standard deviation		0.37	50.91	52334.60	0.40	0.58	0.32
CEH3	R	Average	3	167.72	43.33	546.57	142.33	130.49	124.71
		Standard deviation		0.12	1.53	8.65	0.12	0.26	0.37
CEH3	L	Average	3	155.92	52.33	101881.25	130.82	116.24	109.72
		Standard deviation		0.24	9.24	28520.36	0.29	0.06	0.00
CEH4	R	Average	3	162.34	54.00	5001.46	137.29	124.22	118.16
		Standard deviation		0.70	8.66	1046.15	0.58	0.68	1.65
CEH4	L	Average	1	155.78	45.00	127292.01	130.76	117.66	111.64
CEI3	R	Average	3	168.81	42.67	339.37	143.06	131.13	125.16
		Standard deviation		0.20	0.58	25.67	0.26	0.23	0.23
CEI3	L	Average	Lost						
		Standard deviation							
CEI4	R	Average	3	164.50	42.33	2492.61	139.15	127.06	120.63
		Standard deviation		0.11	1.15	129.71	0.28	0.16	0.10
CEI4	L	Average	Lost						
		Standard deviation							

Table C-14.

Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 3 meter distance, level 3.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
CEH2	R	Average	3	176.34	43.00	10.58	150.75	138.34
		Standard deviation		0.02	5.20	1.53	0.17	0.07
CEH2	L	Average	3	163.76	39.33	4286.09	139.13	123.81
		Standard deviation		0.45	16.20	1365.10	0.39	0.47
CEH3	R	Average	3	164.64	42.67	2369.01	138.40	126.58
		Standard deviation		0.25	6.81	486.59	0.18	0.31
CEH3	L	Average	3	156.54	50.33	7878.42	132.20	117.42
		Standard deviation		0.29	4.04	17299.61	0.45	0.33
CEH4	R	Average	3	168.60	34.67	502.09	142.03	130.30
		Standard deviation		0.37	5.03	101.74	0.15	0.43
CEH4	L	Average	1	155.99	49.00	103234.59	131.71	117.82
		Standard deviation						114.16
CEI2	R	Average	3	169.56	52.67	186.78	144.47	131.61
		Standard deviation		0.71	7.57	47.55	0.42	0.75
CEI2	L	Average	3	160.17	32.00	27955.52	134.44	120.71
		Standard deviation		0.73	1.73	10708.75	0.78	0.74
CEI3	R	Average	3	171.41	44.00	98.46	145.12	133.36
		Standard deviation		0.13	1.73	7.85	0.12	0.25
CEI3	L	Average	Lost					
		Standard deviation						
CEI4	R	Average	3	166.00	37.67	1505.76	140.31	127.80
		Standard deviation		0.16	7.09	332.33	0.06	0.16
CEI4	L	Average	3	161.06	61.33	7443.36	136.85	121.32
		Standard deviation		0.21	3.21	772.94	0.12	0.19

Table C-15.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 3 meter distance, level 4.

Subject	Ear	N	Peak in dB SPL	B- Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
CEH2	R	Average	11	172.22	49.73	59.59	146.95	134.34
		Standard deviation		0.23	7.23	13.80	0.22	0.31
CEH2	L	Average	11	161.19	49.09	11704.92	137.23	120.97
		Standard deviation		0.36	25.99	5196.96	0.51	0.38
CEH3	R	Average	3	173.32	44.67	39.90	147.48	135.57
		Standard deviation		0.11	0.58	2.25	0.21	0.06
CEH3	L	Average	Lost					0.25
		Standard deviation						
CEH4	R	Average	3	169.15	41.00	335.18	143.33	130.47
		Standard deviation		1.31	1.00	154.18	0.61	1.19
CEH4	L	Average	Lost					
		Standard deviation						
CEI2	R	Average	2	171.51	56.50	67.23	146.68	132.76
		Standard deviation		0.26	0.71	6.95	0.16	0.33
CEI2	L	Average	2	157.87	51.50	42059.24	132.93	117.38
		Standard deviation		0.27	7.78	13548.14	0.00	0.18
CEI3	R	Average	2	174.74	38.00	28.58	147.82	136.47
		Standard deviation		2.03	9.90	15.86	0.77	1.73
CEI3	L	Average	Lost					1.82
		Standard deviation						
CEI4	R	Average	2	167.92	42.50	523.00	142.62	128.79
		Standard deviation		0.68	0.71	149.72	0.15	0.33
CEI4	L	Average	Lost					0.56
		Standard deviation						

Table C-16.

Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 3 meter distance, level 5.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	MIL-STD-1474	ANR	Weighted SEL in dB SPL		
								Linear	A-WT	P-WT
CEH2	R	Average	10	175.47	42.90		15.84	149.04	136.30	133.59
		Standard deviation		0.40	0.57		2.70	0.19	0.34	0.83
CEH2	L	Average	10	166.84	35.40		1104.62	142.32	125.92	119.12
		Standard deviation		0.33	6.04		186.58	0.26	0.47	0.69
CEI2	R	Average	2	173.36	51.50		32.94	147.98	133.23	127.78
		Standard deviation		0.46	10.61		2.17	0.19	0.29	0.06
CEI2	L	Average	2	162.13	61.50		4522.11	137.94	121.48	114.57
		Standard deviation		0.12	0.71		319.09	0.40	0.09	0.11
CEI3	R	Average	2	176.15	44.00		11.03	149.74	137.51	133.76
		Standard deviation		0.02	1.41		0.35	0.00	0.02	0.32
CEI3	L	Average	Lost							
		Standard deviation								
CEI4	R	Average	2	174.09	37.00		37.27	147.35	134.39	129.42
		Standard deviation		0.12	7.07		11.32	0.17	0.21	0.60
CEI4	L	Average	1	169.35	34.00		356.07	144.50	128.96	123.28
		Standard deviation								

Table C-17.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 3 meter distance, level 6.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
CEH1	R	Average	6	176.21	38.67	13.96	150.85	136.84
		Standard deviation		1.11	5.16	6.76	0.62	1.13
CEH1	L	Average	5	167.45	36.80	886.09	144.94	128.34
		Standard deviation		1.08	16.90	239.59	0.42	0.63
CEH3	R	Average	9	172.21	43.78	150.97	146.66	133.41
		Standard deviation		4.01	7.14	112.04	3.43	4.00
CEH3	L	Average	3	166.64	27.33	1664.10	142.43	126.65
		Standard deviation		0.20	0.58	162.27	0.55	0.43
CEH4	R	Average	6	175.56	33.67	20.91	148.54	136.37
		Standard deviation		0.33	4.08	1.65	0.21	0.68
CEH4	L	Average	8	163.89	36.75	4976.04	138.22	124.00
		Standard deviation		1.20	15.20	2743.38	0.88	0.51
CEH5	R	Average	3	175.20	47.67	16.15	150.45	136.85
		Standard deviation		0.58	8.96	5.39	0.24	0.12
CEH5	L	Average	3	164.55	31.00	3780.87	141.43	124.38
		Standard deviation		0.28	4.36	860.83	0.40	0.30
CEI2	R	Average	2	178.23	32.50	9.17	151.52	138.87
		Standard deviation		2.86	0.71	9.36	0.69	2.55
CEI2	L	Average	3	167.70	42.33	721.75	143.37	127.53
		Standard deviation		1.45	5.51	597.56	0.95	1.47
CEI3	R	Average	3	177.98	35.67	6.64	151.45	139.19
		Standard deviation		0.38	5.51	2.20	0.28	0.28
CEI3	L	Average	2	169.17	26.00	623.91	144.70	129.12
		Standard deviation		0.32	8.49	347.59	0.38	0.33

Table C-18.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 3 meter distance, level 7.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
							Linear	A-WT	P-WT
CEH1	R	Average	2	178.17	32.00	6.67	152.70	138.58	134.08
		Standard deviation		0.25	2.83	0.03	0.32	0.32	0.55
CEH1	L	Average	2	173.15	23.50	112.52	147.25	132.95	127.15
		Standard deviation		0.72	4.95	65.11	0.42	1.15	1.18
CEH3	R	Average	1	172.48	68.00	33.66	147.48	132.83	129.93
		Standard deviation							
CEH3	L	Average	2	169.76	29.00	394.22	145.82	130.20	123.28
		Standard deviation		0.47	11.31	122.46	0.61	0.66	0.29
CEH4	R	Average	3	177.55	28.00	10.83	150.60	137.46	133.57
		Standard deviation		0.56	0.00	2.89	0.10	0.33	0.50
CEH4	L	Average	1	165.78	55.00	974.74	141.49	125.84	120.47
		Standard deviation							
CEI2	R	Average		Lost					
		Standard deviation							
CEI2	L	Average	2	167.16	35.00	1048.89	144.15	127.06	119.52
		Standard deviation		1.16	18.38	208.32	0.75	1.18	0.68
CEI3	R	Average	2	179.21	29.50	4.70	153.25	139.71	136.02
		Standard deviation		0.42	2.12	1.34	0.31	0.31	0.99
CEI3	L	Average	2	171.43	22.00	243.35	146.69	131.64	126.57
		Standard deviation		0.03	0.00	3.69	0.36	0.29	0.51
CEI4	R	Average	2	175.86	28.50	22.52	150.10	136.02	132.22
		Standard deviation		0.30	0.71	2.38	0.31	0.23	0.48
CEI4	L	Average		Lost					
		Standard deviation							

Appendix D.

Pressure-time signatures and summary data tables for the 5-meter exposure distance.

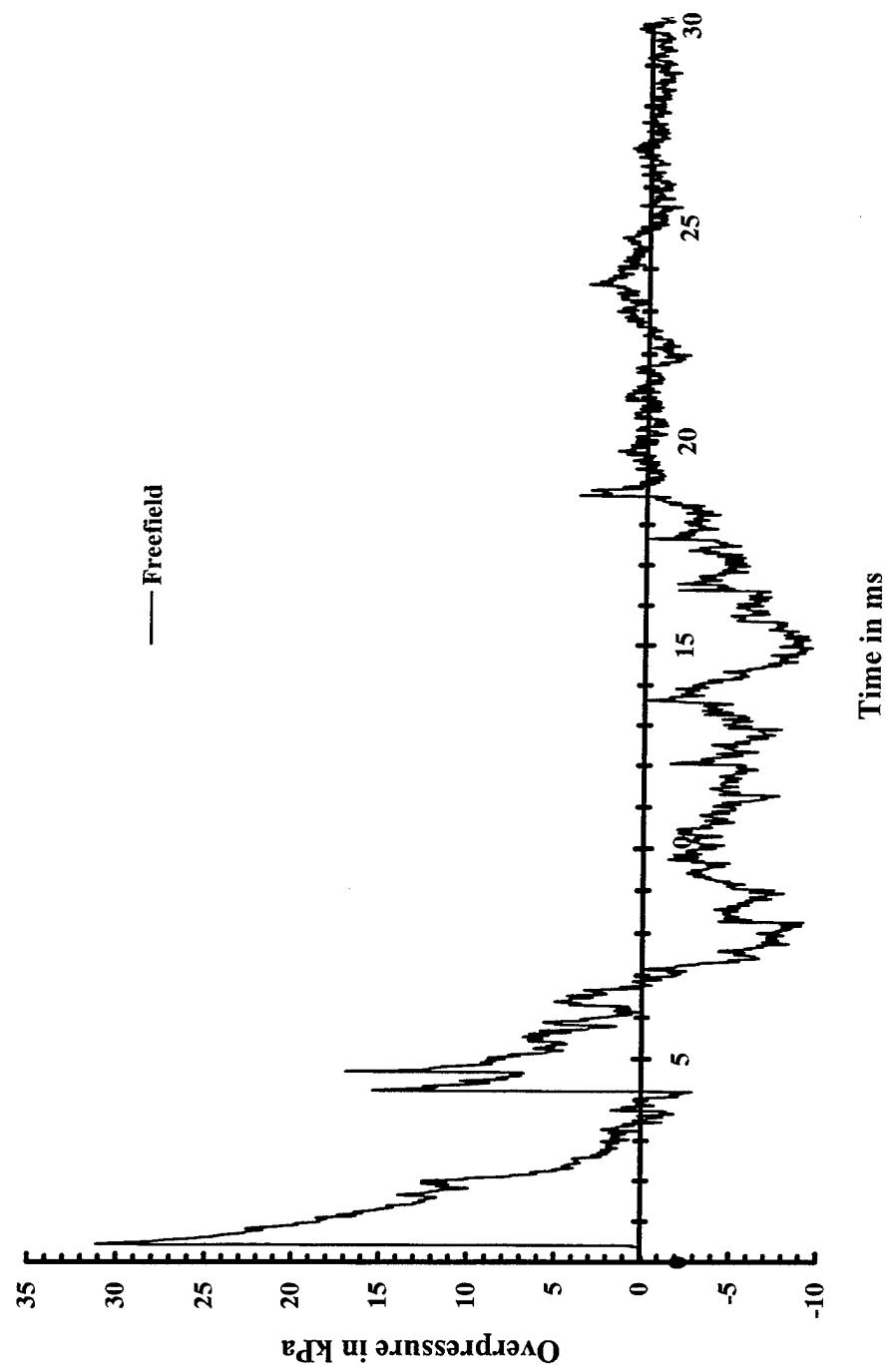


Figure D-1. Pressure-time signature measured in the freefield at the 5-meter distance.

D-2

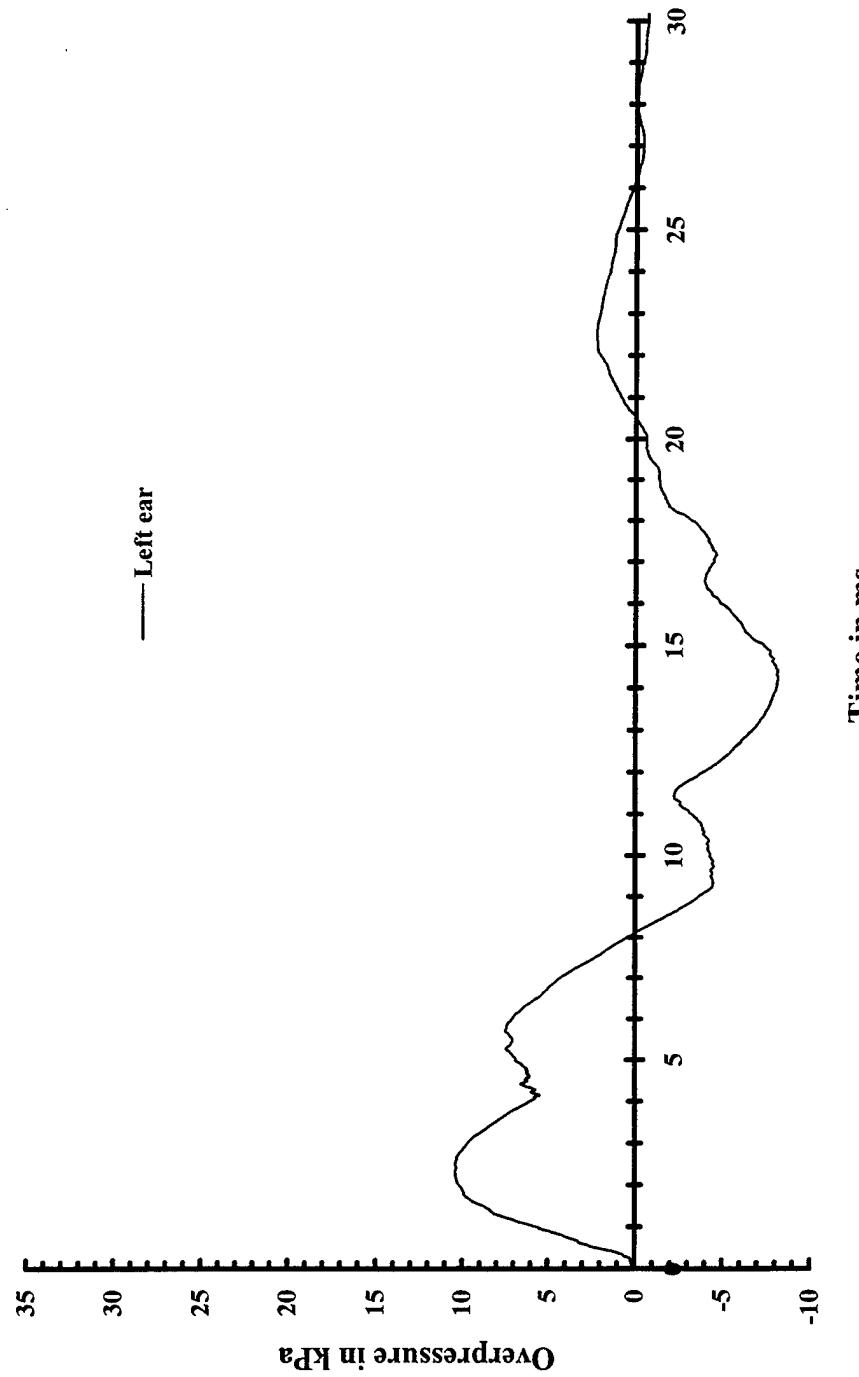


Figure D-2. Pressure-time signature measured under the right earmuff at the 5-meter distance.

D-3

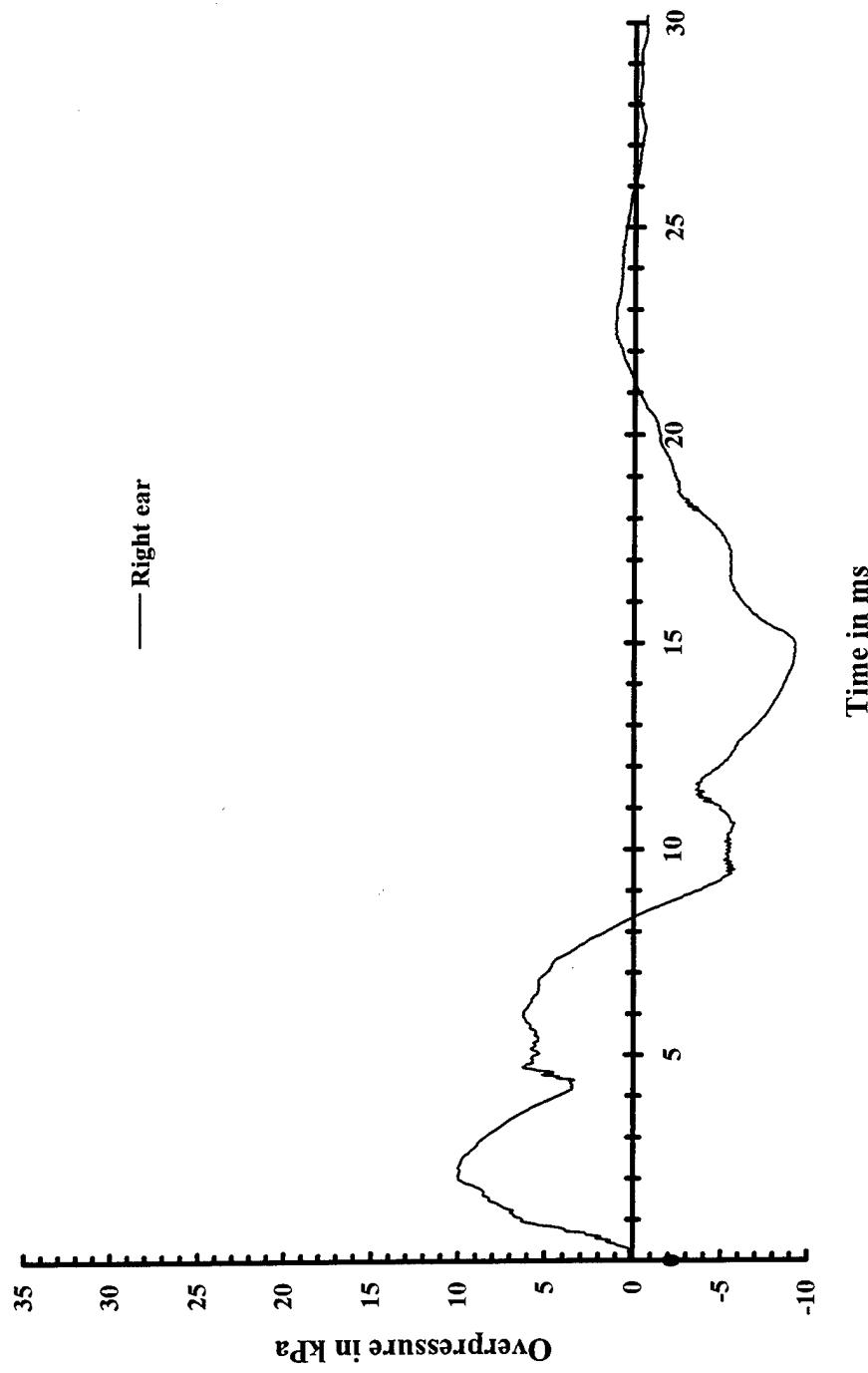


Figure D-3. Pressure-time signature measured under the left earmuff at the 5-meter distance.

Table D-1.
**Average and standard deviation of selected parameters measured outside
 the earmuffs at the 5-meter distance.**

Level		N	Peak in kPa	Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m			
							Linear		A-WT	
				A	B				P-WT	
1	Average	12	9.16	2.01	19.75	8.74	183.20	50.23	58.74	
	Standard deviation		0.54	0.17	4.07	0.22	12.52	4.39	6.84	
2	Average	12	12.65	2.21	18.25	12.30	335.06	85.35	109.11	
	Standard deviation		0.52	0.05	2.34	0.24	19.53	7.23	13.99	
3	Average	12	18.25	2.34	19.58	17.80	737.89	176.69	218.40	
	Standard deviation		1.15	0.11	2.81	0.62	23.89	10.64	19.97	
4	Average	12	24.96	2.58	21.17	24.91	1468.89	311.40	381.78	
	Standard deviation		1.41	0.13	5.36	0.79	65.64	22.62	50.98	
5	Average	12	31.86	2.93	21.17	33.87	2669.06	523.27	640.59	
	Standard deviation		0.95	0.11	2.33	1.15	206.11	78.25	102.02	
6	Average	2	44.29	2.78	20.00	47.19	5818.95	1130.92	1257.71	
	Standard deviation		4.01	0.06	1.41	0.17	321.40	231.87	181.97	
7	Average	8	59.51	2.98	21.50	64.59	9918.78	1620.13	1905.09	
	Standard deviation		4.67	0.19	4.72	2.24	568.89	131.28	210.82	

Table D-2.
Average and standard deviation of selected parameters in dB measured
outside the earmuffs at the 5-meter distance.

Level	N	Peak in dB SPL	B-duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
					Linear	A-WT	P-WT
1	Average	12	173.20	19.75	130.94	142.80	137.17
	Standard deviation		0.51	4.07	29.56	0.30	0.39
2	Average	12	176.02	18.25	38.50	145.43	139.48
	Standard deviation		0.36	2.34	5.31	0.26	0.37
3	Average	12	179.19	19.58	8.17	148.86	142.65
	Standard deviation		0.55	2.81	1.18	0.14	0.27
4	Average	12	181.91	21.17	2.23	151.85	145.10
	Standard deviation		0.52	5.36	0.65	0.19	0.32
5	Average	12	184.04	21.17	0.80	154.43	147.32
	Standard deviation		0.26	2.33	0.19	0.34	0.66
6	Average	2	186.89	20.00	0.24	157.83	150.67
	Standard deviation		0.79	1.41	0.10	0.24	0.90
7	Average	8	189.45	21.50	0.07	160.14	152.26
	Standard deviation		0.69	4.72	0.03	0.25	0.36

Table D-3.
Between subject average and standard deviation of selected parameters measured under the muffs at the 5-meter distance.

Level	Ear	N	Peak in kPa	Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
				A	B		Linear	A-WT	P-WT
1	R	Average	6	2.02	6.03	21.22	5.89	37.72	0.63
		Standard deviation		0.41	0.53	2.75	1.53	18.72	0.18
L	Average	5	2.03	6.00	23.67	6.48	45.50	0.54	0.29
		Standard deviation		0.39	0.46	4.19	2.14	25.26	0.17
2	R	Average	6	2.63	6.55	20.61	9.39	82.36	0.78
		Standard deviation		0.50	0.41	1.63	2.25	36.24	0.25
L	Average	6	2.59	6.69	23.89	9.77	92.80	0.76	0.18
		Standard deviation		0.82	0.28	4.72	3.34	53.17	0.37
3	R	Average	6	3.53	7.48	25.06	13.57	161.75	1.51
		Standard deviation		0.52	0.39	4.16	2.50	53.84	0.29
L	Average	6	3.57	7.47	26.00	14.31	183.26	1.52	0.30
		Standard deviation		0.95	0.55	4.45	4.52	86.11	0.57
4	R	Average	6	5.16	8.13	29.44	23.34	454.99	3.36
		Standard deviation		0.83	0.43	4.48	4.80	171.79	0.81
L	Average	6	5.47	7.66	27.64	24.16	494.29	3.19	0.66
		Standard deviation		1.53	0.47	4.81	8.20	223.59	1.23
5	R	Average	6	7.43	8.35	31.72	37.19	1180.84	10.14
		Standard deviation		1.47	0.35	4.52	7.10	398.16	4.24
L	Average	6	7.58	8.07	31.78	37.48	1153.21	9.41	2.08
		Standard deviation		2.38	0.30	6.62	12.43	543.34	5.76
6	R	Average	6	10.24	8.68	31.31	56.81	2337.13	19.67
		Standard deviation		3.16	0.34	6.39	8.48	797.39	7.59
L	Average	6	10.61	8.20	32.25	55.11	2186.92	19.13	4.19
		Standard deviation		3.16	0.26	6.40	17.11	957.46	12.86
7	R	Average	6	14.04	8.47	34.25	77.15	4314.78	54.41
		Standard deviation		2.22	0.57	8.73	10.97	1439.98	35.44
L	Average	6	14.11	7.98	31.67	73.58	4006.45	43.57	9.57
		Standard deviation		3.71	0.26	5.72	21.28	1280.79	18.73

Table D-4.

Between subject average and standard deviation of selected parameters in dB measured under the muffs at the 5-meter distance.

Level	Ear	N	Peak in dB SPL	B-duration in ms	ANR		Weighted SEL in db SPL	
					MIL-STD-1474	Linear	A-WT	P-WT
1	R	Average	6	159.90	21.22	77313.35	135.41	117.98
		Standard deviation		1.92	2.75	75927.41	2.45	1.46
L	Average	5	159.99	23.67	54283.64	136.15	117.24	3.17
		Standard deviation		1.75	4.19	45488.76	2.65	1.57
2	R	Average	6	162.24	20.61	25335.19	138.85	118.87
		Standard deviation		1.79	1.63	23260.08	2.41	1.67
L	Average	6	161.79	23.89	42028.86	139.00	118.46	113.35
		Standard deviation		3.17	4.72	62741.64	3.26	2.46
3	R	Average	6	164.84	25.06	49254.40	142.02	121.89
		Standard deviation		1.33	4.16	2437.14	1.64	0.87
L	Average	6	164.77	26.00	6570.62	142.35	121.71	113.75
		Standard deviation		2.41	4.45	6364.70	2.27	1.74
4	R	Average	6	168.13	29.44	921.41	146.47	125.32
		Standard deviation		1.49	4.48	598.88	1.70	1.06
L	Average	6	168.43	27.64	1046.80	146.74	124.93	116.42
		Standard deviation		2.48	4.81	997.19	1.95	1.70
5	R	Average	6	171.26	31.72	230.62	150.67	129.90
		Standard deviation		1.68	4.52	175.13	1.54	1.77
L	Average	6	171.25	31.78	230.59	150.41	129.30	120.03
		Standard deviation		2.52	6.62	173.18	1.89	1.38
6	R	Average	6	174.07	31.31	66.41	153.63	132.84
		Standard deviation		1.48	6.39	56.17	1.55	1.66
L	Average	6	174.16	32.25	67.87	153.22	132.31	125.28
		Standard deviation		2.65	6.40	63.91	1.95	2.55
7	R	Average	6	176.83	34.25	13.84	156.31	136.91
		Standard deviation		1.32	8.73	7.50	1.50	2.34
L	Average	5	176.06	32.40	32.90	155.63	135.69	129.13
		Standard deviation		2.10	6.08	37.24	1.18	1.92

Table D-5.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 1.

Subject	Ear	N	Peak in ms		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m		
			kPa	A	B			Linear	A-WT	P-WT	
BHL1	R	Average	3	2.35	6.24	17.00	7.32	59.33	0.72	0.25	0.01
BHL1	L	Average	3	2.39	6.22	22.00	8.88	77.74	0.58	0.15	0.01
BHL3	R	Average	3	1.80	5.26	19.00	4.55	21.14	0.47	0.12	0.00
BHL3	L	Average	3	1.49	5.66	24.33	3.86	17.07	0.29	0.07	0.01
BHL4	R	Average	3	2.44	5.59	24.00	7.09	45.85	0.73	0.20	0.01
BHL4	L	Average	3	1.91	5.68	27.33	6.08	36.87	0.44	0.23	0.01
BHM1	R	Average	3	2.29	5.95	22.33	7.23	56.25	0.75	0.54	0.21
BHM1	L	Average	3	2.44	6.71	17.33	8.43	65.50	0.63	0.30	0.15
BHM3	R	Average	3	1.36	6.55	23.67	3.79	14.89	0.34	0.12	0.01
BHM3	L	lost									
BHM4	R	Average	3	1.86	6.59	21.33	5.39	28.86	0.79	0.85	0.51
BHM4	L	Average	3	1.91	5.75	27.33	5.17	30.34	0.74	0.71	0.38

Table D-6.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 2.

Subject	Ear		N	Peak in kPa		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m		
				A	B	A	B	Linear	A-WT	P-WT		
BHL1	R	Average	3	2.79	6.79	21.00	10.60	110.76	0.89	0.32		
BHL1	R	Standard deviation		0.07	0.19	0.00	0.19	3.29	0.02	0.02		
BHL1	L	Average	3	3.12	7.14	18.33	12.96	136.49	0.85	0.17		
BHL1	L	Standard deviation		0.04	0.20	2.31	0.21	4.29	0.02	0.01		
BHL3	R	Average	3	2.97	6.63	21.67	10.65	105.49	1.06	0.31		
BHL3	R	Standard deviation		0.09	0.11	5.51	0.25	4.04	0.11	0.06		
BHL3	L	Average	3	1.34	6.62	28.67	4.91	23.47	0.27	0.07		
BHL3	L	Standard deviation		0.07	0.04	1.15	0.11	2.80	0.03	0.01		
BHL4	R	Average	3	1.86	6.84	21.33	6.59	34.88	0.37	0.12		
BHL4	R	Standard deviation		0.04	0.18	4.93	0.28	3.17	0.01	0.01		
BHL4	L	Average	3	3.46	6.68	27.33	12.67	154.67	1.30	0.25		
BHL4	L	Standard deviation		0.11	0.07	0.58	0.49	10.35	0.02	0.01		
BHM1	R	Average	3	2.93	6.96	17.33	11.43	110.76	0.85	0.31		
BHM1	R	Standard deviation		0.03	0.03	0.58	0.05	5.39	0.01	0.02		
BHM1	L	Average	3	3.10	6.87	19.67	11.72	121.05	0.95	0.21		
BHM1	L	Stan. Dev.		0.02	0.06	2.31	0.10	6.60	0.02	0.01		
BHM3	R	Average	3	2.16	6.08	21.00	6.43	37.53	0.60	0.15		
BHM3	R	Standard deviation		0.07	0.05	3.46	0.10	0.39	0.04	0.01		
BHM3	L	Average	3	1.89	6.34	28.33	6.66	41.65	0.46	0.10		
BHM3	L	Standard deviation		0.05	0.08	0.58	0.29	2.85	0.02	0.01		
BHM4	R	Average	3	3.08	6.01	21.33	10.66	94.71	0.93	0.26		
BHM4	R	Standard deviation		0.02	0.03	4.93	0.16	2.18	0.02	0.01		
BHM4	L	Average	3	2.60	6.51	21.00	9.73	79.48	0.72	0.27		
BHM4	L	Standard deviation		0.13	0.26	5.20	0.16	6.75	0.12	0.02		

Table D-7.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 3.

Subject	Ear	Average	N	Peak in kPa		Durations in ms		A'-impulse in kPa*ms		Weighted energy in J/m*m		
				A	B	A	B	Linear	A-WT	P-WT		
BHL1	R	Average	3	4.00	7.86	20.67	15.02	209.46	1.65	0.46		
BHL1	R	Standard deviation		0.19	0.45	4.62	0.13	19.80	0.20	0.06		
BHL1	L	Average	3	4.82	8.10	22.33	20.06	296.27	2.35	0.43		
BHL1	L	Standard deviation		0.22	0.03	0.58	0.26	16.95	0.32	0.06		
BHL3	R	Average	3	2.72	7.07	29.67	9.41	82.17	1.15	0.28		
BHL3	R	Standard deviation		0.09	0.04	0.58	0.44	10.64	0.09	0.02		
BHL3	L	Average	3	2.36	6.92	31.00	8.71	75.00	0.80	0.15		
BHL3	L	Standard deviation		0.03	0.07	0.00	0.69	10.98	0.03	0.01		
BHL4	R	Average	3	3.93	7.77	21.00	15.95	181.82	1.78	0.57		
BHL4	R	Standard deviation		0.11	0.09	6.93	0.49	11.02	0.10	0.03		
BHL4	L	Average	3	3.92	7.43	28.67	15.77	199.70	1.75	0.37		
BHL4	L	Standard deviation		0.04	0.03	0.58	0.23	7.44	0.02	0.03		
BHM1	R	Average	3	3.93	7.80	23.00	15.53	223.98	1.83	0.52		
BHM1	R	Standard deviation		0.04	0.17	1.00	0.37	6.89	0.08	0.02		
BHM1	L	Average	3	4.31	8.19	20.33	18.45	264.11	1.84	0.33		
BHM1	L	Standard deviation		0.14	0.18	2.08	0.18	8.50	0.13	0.04		
BHM3	R	Average	3	3.17	6.97	26.00	12.01	123.53	1.19	0.34		
BHM3	R	Standard deviation		0.16	0.15	4.36	0.60	13.31	0.07	0.06		
BHM3	L	Average	3	2.68	7.00	23.67	10.46	115.39	1.01	0.18		
BHM3	L	Standard deviation		0.10	0.05	3.79	0.21	6.71	0.02	0.01		
BHM4	R	Average	3	3.41	7.40	30.00	13.51	149.51	1.47	0.44		
BHM4	R	Standard deviation		0.03	0.13	0.00	0.14	2.83	0.08	0.01		
BHM4	L	Average	3	3.36	7.20	30.00	12.41	149.07	1.37	0.32		
BHM4	L	Standard deviation		0.04	0.06	0.00	0.24	6.87	0.04	0.03		

Table D-8.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 4.

Subject	Ear	N	Peak in kPa	Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m	
				A	B	Linear	A-WT	P-WT	
BHL1	R	Average	3	5.91	8.28	22.67	26.69	659.88	4.61
BHL1	R	Standard deviation		0.16	0.10	2.31	1.41	74.69	1.62
BHL1	L	Average	3	7.54	8.03	21.33	33.63	766.71	0.27
BHL1	L	Standard deviation		0.13	0.16	2.89	1.30	54.86	0.03
BHL3	R	Average	3	4.76	7.34	27.67	20.08	338.42	4.88
BHL3	R	Standard deviation		0.31	0.31	5.86	1.59	50.71	0.46
BHL3	L	Average	2	4.82	6.99	26.50	21.51	451.65	2.87
BHL3	L	Standard deviation		0.47	0.02	4.95	2.14	87.08	0.90
BHL4	R	Average	3	4.99	8.08	31.00	21.03	315.89	0.47
BHL4	R	Standard deviation		0.22	0.26	0.00	0.88	33.99	0.05
BHL4	L	Average	3	4.68	7.35	31.00	17.13	290.63	2.53
BHL4	L	Standard deviation		0.17	0.21	0.00	0.22	30.30	0.08
BHM1	R	Average	3	5.65	8.60	28.67	27.75	627.45	3.71
BHM1	R	Standard deviation		0.24	0.08	2.31	0.23	62.68	0.25
BHM1	L	Average	3	7.02	8.26	23.33	33.91	773.47	1.04
BHM1	L	Standard deviation		0.43	0.03	0.58	1.25	72.34	0.09
BHM3	R	Average	3	3.79	8.35	36.33	16.50	260.95	4.47
BHM3	R	Standard deviation		0.21	0.27	5.77	0.15	16.73	0.49
BHM3	L	Average	3	3.47	7.51	34.00	14.43	278.72	1.78
BHM3	L	Standard deviation		0.08	0.04	2.65	0.36	27.77	0.32
BHM4	R	Average	3	5.89	8.12	30.33	27.99	527.37	0.26
BHM4	R	Standard deviation		0.22	0.33	0.58	0.84	11.49	0.05
BHM4	L	Average	3	5.26	7.79	29.67	24.33	404.60	3.75
BHM4	L	Standard deviation		0.19	0.24	1.53	0.49	9.01	1.24

Table D-9.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 5.

Subject	Ear		N	Peak in ms		Durations in ms		A-impulse in kPa*ms		Weighted energy in J/m*m	
				kPa		A	B	Linear	A-WT	P-WT	
BHL1	R	Average	3	9.68	8.13	27.00		44.69	1685.54	17.10	5.21
BHL1	R	Standard deviation		1.08	0.30	5.20		2.48	141.39	2.99	0.85
BHL1	L	Average	3	11.77	7.85	24.00		56.85	2114.00	19.92	4.05
BHL1	L	Standard deviation		0.74	0.17	0.00		3.82	241.74	3.19	0.40
BHL3	R	Average	3	6.27	7.72	27.67		26.20	684.73	6.84	2.56
BHL3	R	Standard deviation		0.16	0.22	8.39		0.82	30.44	0.57	0.19
BHL3	L	Average	3	5.33	7.67	34.33		24.58	685.23	4.40	1.02
BHL3	L	Standard deviation		0.06	0.17	1.15		0.65	27.61	0.59	0.14
BHL4	R	Average	3	8.33	8.59	38.33		42.92	1449.87	10.34	4.50
BHL4	R	Standard deviation		0.16	0.16	6.35		1.44	160.21	0.77	0.59
BHL4	L	Average	3	7.24	8.22	39.00		34.77	953.18	7.46	2.80
BHL4	L	Standard deviation		0.27	0.17	4.36		1.55	193.96	0.56	0.21
BHM1	R	Average	3	7.94	8.57	33.67		41.64	1447.51	12.72	4.47
BHM1	R	Standard deviation		0.05	0.06	7.51		0.18	24.57	1.16	0.34
BHM1	L	Average	3	8.83	8.54	23.33		48.19	1434.78	12.05	2.33
BHM1	L	Standard deviation		0.34	0.10	2.08		2.01	66.65	1.08	0.18
BHM3	R	Average	3	5.85	8.57	29.00		33.82	898.42	8.11	2.51
BHM3	R	Standard deviation		0.06	0.31	8.19		3.38	53.13	2.17	0.80
BHM3	L	Average	3	6.25	8.08	33.00		31.78	1023.69	6.92	1.28
BHM3	L	Standard deviation		0.48	0.25	1.73		3.89	121.00	2.16	0.39
BHM4	R	Average	3	6.53	8.52	34.67		33.84	918.98	5.71	1.38
BHM4	R	Standard deviation		0.18	0.14	1.15		2.10	197.22	0.37	0.14
BHM4	L	Average	3	6.07	8.05	37.00		28.72	708.35	5.73	0.97
BHM4	L	Standard deviation		0.18	0.27	6.00		1.79	171.62	0.55	0.16

Table D-10.

Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 6.

Subject	Ear		N	Peak in kPa	Durations in ms		A-impulse in kPa*ms	Weighted energy in J/m*m		
					A	B		Linear	A-WT	P-WT
BHL1	R	Average	2	12.84	8.36	29.50	64.18	3315.90	32.65	10.69
BHL1	R	Standard deviation		0.62	0.03	0.71	0.10	33.21	0.92	0.26
BHL1	L	Average	2	13.41	8.11	31.00	64.06	2766.33	23.27	4.54
BHL1	L	Standard deviation		0.34	0.03	2.83	2.35	123.22	1.73	0.75
BHL3	R	Average	2	8.75	8.47	25.00	48.71	1706.72	16.68	5.38
BHL3	R	Standard deviation		0.75	0.14	7.07	4.74	211.02	0.03	0.22
BHL3	L	Average	2	9.65	7.84	27.00	45.91	1974.79	12.58	2.29
BHL3	L	Standard deviation		0.45	0.24	4.24	2.56	98.38	0.26	0.10
BHL4	R	Average	2	9.80	9.28	42.00	57.00	1724.32	11.16	2.66
BHL4	R	Standard deviation		1.39	0.03	7.07	7.28	480.80	3.30	0.35
BHL4	L	Average	2	8.54	8.42	32.50	48.20	1085.29	12.61	2.26
BHL4	L	Standard deviation		1.27	0.13	0.71	4.53	116.16	2.70	0.43
BHM1	R	Average	3	11.14	8.82	34.67	59.57	2896.73	20.75	6.50
BHM1	R	Standard deviation		0.26	0.10	6.43	2.26	195.48	2.34	1.02
BHM1	L	Average	3	15.09	8.56	25.67	83.83	3723.80	43.31	11.57
BHM1	L	Standard deviation		0.18	0.08	1.15	3.30	254.66	4.65	1.63
BHM3	R	Average	3	8.06	8.44	25.33	44.99	1450.82	14.28	3.80
BHM3	R	Standard deviation		0.18	0.26	0.58	2.12	96.76	0.49	0.36
BHM3	L	Average	3	6.53	8.06	43.67	34.45	1394.92	8.05	1.42
BHM3	L	Standard deviation		0.33	0.03	11.02	1.91	200.60	1.03	0.30
BHM4	R	Average	3	10.84	8.74	31.33	66.43	2928.30	22.52	7.76
BHM4	R	Standard deviation		0.65	0.17	0.58	3.12	77.93	1.99	1.10
BHM4	L	Average	3	10.45	8.22	33.67	54.19	2176.42	14.97	3.07
BHM4	L	Standard deviation		0.48	0.05	1.15	0.48	15.11	0.69	0.16

Table D-11.
Average and standard deviation of selected parameters measured under the muffs of individual subjects at the 5-meter distance, level 7.

Subject	Ear		N	Peak in ms		Durations in ms		A-impulse in kPa*ms			Weighted energy in J/m*m		
				kPa	A	B	Linear	A-WT	P-WT	Linear	A-WT	P-WT	
BHL1	R	Average	2	13.06	8.25	32.00	71.67	4533.98	46.47	11.87			
BHL1	R	Standard deviation		1.57	0.17	1.41	5.58	45.99	16.71	4.86			
BHL1	L	Average	2	19.42	8.06	28.00	104.22	5884.11	68.59	14.00			
BHL1	L	Standard deviation		0.59	0.01	2.83	0.13	16.96	, 5.90	4.26			
BHL3	R	Average	2	12.60	9.25	30.00	69.82	2614.82	32.80	9.10			
BHL3	R	Standard deviation		0.49	1.32	1.41	9.86	143.89	2.24	3.48			
BHL3	L	Average	2	8.94	7.90	27.50	43.70	2543.51	18.52	3.87			
BHL3	L	Standard deviation		0.25	0.06	9.19	1.45	380.01	0.54	0.89			
BHL4	R	Average	2	17.62	7.92	31.00	89.19	5835.10	54.41	13.20			
BHL4	R	Standard deviation		0.04	0.25	1.41	1.63	876.42	4.03	0.40			
BHL4	L	Average	1	14.79	7.68	40.00	71.40	4937.85	32.58	6.80			
BHL4	L	Standard deviation		NA	NA	NA	NA	NA	NA	NA			
BHM1	R	Average	2	16.02	8.24	30.50	92.87	6075.11	123.75	62.14			
BHM1	R	Standard deviation		0.36	0.18	2.12	4.12	228.59	21.50	11.33			
BHM1	L	Average	2	15.86	8.19	38.00	87.74	4392.38	61.15	13.14			
BHM1	L	Standard deviation		0.69	0.01	7.07	8.41	1081.07	6.04	1.00			
BHM3	R	Average	2	12.37	8.04	30.00	67.00	2967.71	43.18	16.50			
BHM3	R	Standard deviation		1.65	0.03	1.41	5.11	407.36	3.24	0.86			
BHM3	L	Average	2	10.95	7.72	28.00	58.67	3240.21	45.28	9.41			
BHM3	L	Standard deviation		0.57	0.21	8.49	0.23	329.39	8.00	2.06			
BHM4	R	Average	2	12.59	9.12	52.00	72.39	3861.96	25.85	6.55			
BHM4	R	Standard deviation		0.72	0.88	2.83	2.26	367.07	4.78	1.16			
BHM4	L	Average	2	14.69	8.32	28.50	75.74	3040.67	35.34	10.23			
BHM4	L	Standard deviation		3.67	0.08	4.95	4.33	238.53	11.09	5.77			

Table D-12.

Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 1.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ML-STD-1474	ANR	Weighted SEL in dB SPL		
							Linear	A-WT	P-WT
BHL1	R	Average	3	161.39	17.00	35127.54	137.91	118.75	114.16
BHL1	R	Standard deviation		0.20	0.00	3313.99	0.06	0.22	0.17
BHL1	L	Average	3	161.56	22.00	23029.65	139.09	117.81	111.84
BHL1	L	Standard deviation		0.17	0.00	1859.52	0.15	0.27	0.17
BHL3	R	Average	3	159.09	19.00	92591.85	133.42	116.90	110.97
BHL3	R	Standard deviation		0.44	4.58	32929.41	0.34	0.16	0.00
BHL3	L	Average	3	157.44	24.33	134283.53	132.50	114.80	108.41
BHL3	L	Standard deviation		0.15	0.58	13256.96	0.17	0.15	0.39
BHL4	R	Average	3	161.72	24.00	19617.98	136.79	118.79	113.26
BHL4	R	Standard deviation		0.31	5.20	3528.18	0.28	0.21	0.12
BHL4	L	Average	3	159.61	27.33	42297.65	135.84	116.65	113.80
BHL4	L	Standard deviation		0.15	0.58	3891.01	0.30	0.15	0.19
BHM1	R	Average	3	161.18	22.33	26883.05	137.68	118.91	117.24
BHM1	R	Standard deviation		0.11	0.58	757.94	0.03	0.54	1.83
BHM1	L	Average	3	161.73	17.33	29547.41	138.34	118.17	114.57
BHM1	L	Standard deviation		0.14	2.31	3419.33	0.13	0.31	2.02
BHM3	R	Average	3	156.67	23.67	221715.65	131.90	115.48	111.09
BHM3	R	Standard deviation		0.15	7.51	98732.14	0.32	0.38	0.20
BHM3	L	Lost							
BHM4	R	Average	3	159.37	21.33	67944.01	134.78	119.03	118.67
BHM4	R	Standard deviation		0.14	4.04	15946.36	0.12	1.20	3.52
BHM4	L	Average	3	159.61	27.33	42259.94	135.00	118.77	118.14
BHM4	L	Standard deviation		0.21	0.58	2987.74	0.05	1.16	2.94

Table D-13.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 2.

Subject	Bar		N	Peak in dB SPL	B-Duration in ms	MIL-STD-1474	ANR	Weighted SEL in dB SPL		
								Linear	A-WT	P-WT
BHL1	R	Average	3	162.88	21.00	13345.60	140.62	119.67	115.18	
BHL1	R	Standard deviation		0.21	0.00	1317.04	0.13	0.09	0.21	
BHL1	L	Average	3	163.87	18.33	10273.26	141.53	119.46	112.57	
BHL1	L	Standard deviation		0.11	2.31	1827.09	0.14	0.08	0.14	
BHL3	R	Average	3	163.44	21.67	10309.63	140.41	120.40	115.04	
BHL3	R	Standard deviation		0.25	5.51	2403.02	0.17	0.44	0.85	
BHL3	L	Average	3	156.53	28.67	167059.71	133.86	114.48	108.38	
BHL3	L	Standard deviation		0.48	1.15	43302.95	0.53	0.48	0.72	
BHL4	R	Average	3	159.38	21.33	67759.88	135.59	115.90	110.85	
BHL4	R	Standard deviation		0.19	4.93	14501.45	0.41	0.07	0.22	
BHL4	L	Average	3	164.77	27.33	3950.11	142.07	121.33	114.22	
BHL4	L	Standard deviation		0.27	0.58	453.11	0.29	0.07	0.10	
BHM1	R	Average	3	163.31	17.33	14107.87	140.62	119.46	115.09	
BHM1	R	Standard deviation		0.07	0.58	258.92	0.21	0.03	0.24	
BHM1	L	Average	3	163.80	19.67	9646.30	141.01	119.97	113.47	
BHM1	L	Standard deviation		0.06	2.31	1488.76	0.23	0.10	0.12	
BHM3	R	Average	3	160.67	21.00	37403.62	135.92	117.96	112.04	
BHM3	R	Standard deviation		0.29	3.46	3291.50	0.05	0.26	0.16	
BHM3	L	Average	3	159.51	28.33	42508.39	136.37	116.81	110.03	
BHM3	L	Standard deviation		0.24	0.58	5703.68	0.30	0.16	0.26	
BHM4	R	Average	3	163.76	21.33	9084.52	139.94	119.85	114.33	
BHM4	R	Standard deviation		0.06	4.93	2239.45	0.10	0.10	0.17	
BHM4	L	Average	3	162.27	21.00	18735.36	139.17	118.70	114.44	
BHM4	L	Standard deviation		0.42	5.20	6313.17	0.37	0.71	0.25	

Table D-14.

Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 3.

Subject	Ear		N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
							Linear	A-WT	P-WT
BHL1	R	Average Standard deviation	3	166.02 0.40	20.67 4.62	3484.02 1368.95	143.38 0.41	122.33 0.53	116.75 0.57
BHL1	L	Average Standard deviation	3	167.63 0.39	22.33 0.58	1396.69 283.85	144.89 0.25	123.86 0.59	116.52 0.56
BHL3	R	Average Standard deviation	3	162.68 0.30	29.67 0.58	9272.73 1150.29	139.30 0.59	120.77 0.32	114.64 0.31
BHL3	L	Average Standard deviation	3	161.44 0.13	31.00 0.00	15429.29 924.75	138.90 0.66	119.19 0.14	111.94 0.29
BHL4	R	Average Standard deviation	3	165.86 0.25	21.00 6.93	3765.59 1522.51	142.77 0.26	122.67 0.23	117.71 0.25
BHL4	L	Average Standard deviation	3	165.84 0.08	28.67 0.58	2249.35 144.26	143.18 0.16	122.60 0.06	115.90 0.29
BHM1	R	Average Standard deviation	3	165.87 0.10	23.00 1.00	2987.11 235.12	143.68 0.13	122.79 0.20	117.34 0.17
BHM1	L	Average Standard deviation	3	166.66 0.27	20.33 2.08	2447.42 34.19	144.40 0.14	122.82 0.31	115.35 0.47
BHM3	R	Average Standard deviation	3	164.00 0.44	26.00 4.36	6363.28 2501.86	141.08 0.46	120.92 0.26	115.48 0.86
BHM3	L	Average Standard deviation	3	162.54 0.33	23.67 3.79	13965.47 4393.68	140.80 0.25	120.24 0.09	112.65 0.14
BHM4	R	Average Standard deviation	3	164.64 0.08	30.00 0.00	3679.68 136.92	141.93 0.08	121.86 0.22	116.61 0.10
BHM4	L	Average Standard deviation	3	164.50 0.10	30.00 0.00	3935.52 174.86	141.91 0.20	121.54 0.13	115.27 0.34

Table D-15.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 4.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
BHL1	R	Average	3	169.41	22.67	148.36	126.81	122.28
BHL1	R	Standard deviation		0.23	2.31	145.85	0.51	0.26
BHL1	L	Average	3	171.52	21.33	146.79	149.02	127.05
BHL1	L	Standard deviation		0.15	2.89	31.32	0.31	0.42
BHL3	R	Average	3	167.51	27.67	1187.30	145.44	124.72
BHL3	R	Standard deviation		0.57	5.86	476.29	0.67	0.67
BHL3	L	Average	2	167.62	26.50	1119.08	146.69	124.16
BHL3	L	Standard deviation		0.84	4.95	154.38	0.84	0.95
BHL4	R	Average	3	167.94	31.00	778.34	145.16	124.72
BHL4	R	Standard deviation		0.38	0.00	129.85	0.48	0.32
BHL4	L	Average	3	167.37	31.00	1007.37	144.80	123.90
BHL4	L	Standard deviation		0.31	0.00	136.91	0.44	0.28
BHM1	R	Average	3	169.02	28.67	529.97	148.14	125.86
BHM1	R	Standard deviation		0.37	2.31	99.88	0.42	0.29
BHM1	L	Average	3	170.90	23.33	295.46	149.05	126.67
BHM1	L	Standard deviation		0.54	0.58	84.13	0.41	0.49
BHM3	R	Average	3	165.54	36.33	2012.80	144.34	123.91
BHM3	R	Standard deviation		0.48	5.77	748.08	0.27	0.52
BHM3	L	Average	3	164.78	34.00	2947.91	144.62	122.65
BHM3	L	Standard deviation		0.20	2.65	430.12	0.42	0.65
BHM4	R	Average	3	169.38	30.33	411.82	147.40	125.92
BHM4	R	Standard deviation		0.33	0.58	53.63	0.10	0.18
BHM4	L	Average	3	168.40	29.67	664.22	146.25	125.15
BHM4	L	Standard deviation		0.31	1.53	65.74	0.10	0.17

Table D-16.

Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 5.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
BHL1	R	Average	3	173.66	27.00	80.76	152.44	127.31
BHL1	R	Standard deviation		0.98	5.20	60.53	0.37	0.80
BHL1	L	Average	3	175.38	24.00	35.91	153.41	126.25
BHL1	L	Standard deviation		0.54	0.00	8.37	0.49	0.41
BHL3	R	Average	3	169.92	27.67	394.72	148.53	124.25
BHL3	R	Standard deviation		0.21	8.39	150.63	0.20	0.37
BHL3	L	Average	3	168.52	34.33	516.62	148.54	120.23
BHL3	L	Standard deviation		0.11	1.15	26.91	0.18	0.59
BHL4	R	Average	3	172.39	38.33	76.96	151.78	126.69
BHL4	R	Standard deviation		0.16	6.35	15.03	0.50	0.32
BHL4	L	Average	3	171.17	39.00	132.97	149.91	124.64
BHL4	L	Standard deviation		0.32	4.36	41.87	0.90	0.33
BHM1	R	Average	3	171.98	33.67	113.81	151.79	126.67
BHM1	R	Standard deviation		0.05	7.51	36.58	0.07	0.41
BHM1	L	Average	3	172.89	23.33	115.47	151.75	123.84
BHM1	L	Standard deviation		0.33	2.08	7.81	0.20	0.39
BHM3	R	Average	3	169.32	29.00	488.89	149.71	129.15
BHM3	R	Standard deviation		0.09	8.19	198.51	0.26	1.29
BHM3	L	Average	3	169.87	33.00	297.95	150.26	128.42
BHM3	L	Standard deviation		0.69	1.73	78.36	0.53	1.51
BHM4	R	Average	3	170.28	34.67	228.58	149.75	127.74
BHM4	R	Standard deviation		0.23	1.15	33.08	0.89	0.28
BHM4	L	Average	3	169.65	37.00	284.60	148.60	127.75
BHM4	L	Standard deviation		0.25	6.00	54.57	1.04	0.41

Table D-17.
Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 6.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
BHL1	R	Average	2	176.15	29.50	18.95	155.39	135.32
BHL1	R	Standard deviation	0.42	0.71	3.06	0.04	0.12	0.11
BHL1	L	Average	2	176.53	31.00	14.83	154.60	133.84
BHL1	L	Standard deviation	0.22	2.83	0.30	0.19	0.32	0.72
BHL3	R	Average	2	172.80	25.00	127.33	152.49	132.40
BHL3	R	Standard deviation	0.74	7.07	84.87	0.54	0.01	0.18
BHL3	L	Average	2	173.67	27.00	69.56	153.13	131.18
BHL3	L	Standard deviation	0.41	4.24	26.93	0.22	0.09	0.19
BHL4	R	Average	2	173.76	42.00	41.54	152.46	130.56
BHL4	R	Standard deviation	1.24	7.07	29.95	1.23	1.30	0.58
BHL4	L	Average	2	172.56	32.50	93.40	150.52	131.14
BHL4	L	Standard deviation	1.30	0.71	50.49	0.47	0.94	0.84
BHM1	R	Average	3	174.92	34.67	27.62	154.79	133.33
BHM1	R	Standard deviation	0.20	6.43	6.45	0.29	0.49	0.72
BHM1	L	Average	3	177.55	25.67	11.89	155.88	136.53
BHM1	L	Standard deviation	0.10	1.15	1.23	0.29	0.47	0.64
BHM3	R	Average	3	172.11	25.33	148.22	151.79	131.73
BHM3	R	Standard deviation	0.20	0.58	10.66	0.30	0.15	0.40
BHM3	L	Average	3	170.27	43.67	181.15	151.59	129.22
BHM3	L	Standard deviation	0.44	11.02	69.74	0.65	0.55	0.93
BHM4	R	Average	3	174.67	31.33	34.79	154.85	133.69
BHM4	R	Standard deviation	0.52	0.58	7.24	0.12	0.40	0.64
BHM4	L	Average	3	174.35	33.67	36.38	153.56	131.93
BHM4	L	Standard deviation	0.40	1.15	5.52	0.03	0.20	0.23

Table D-18.

Average and standard deviation of selected parameters in dB measured under the muffs of individual subjects at the 5-meter distance, level 7.

Subject	Ear	N	Peak in dB SPL	B-Duration in ms	ANR MIL-STD-1474	Weighted SEL in dB SPL		
						Linear	A-WT	P-WT
BHL1	R	Average	2	176.27	32.00	17.17	156.75	136.71
BHL1	R	Standard deviation		1.05	1.41	8.86	0.04	1.60
BHL1	L	Average	2	179.74	28.00	3.87	157.88	138.53
BHL1	L	Standard deviation		0.26	2.83	0.05	0.01	0.37
BHL3	R	Average	2	175.98	30.00	19.92	154.35	135.33
BHL3	R	Standard deviation		0.34	1.41	1.84	0.24	0.30
BHL3	L	Average	2	173.00	27.50	93.83	154.21	132.86
BHL3	L	Standard deviation		0.25	9.19	31.17	0.65	0.13
BHL4	R	Average	2	178.90	31.00	4.97	157.82	137.53
BHL4	R	Standard deviation		0.02	1.41	0.26	0.65	0.32
BHL4	L	Average	1	177.38	40.00	7.12	157.12	135.31
BHL4	L	Standard deviation		NA	NA	NA	NA	NA
BHM1	R	Average	2	178.07	30.50	7.44	158.01	141.07
BHM1	R	Standard deviation		0.20	2.12	0.02	0.16	0.76
BHM1	L	Average	2	177.98	38.00	6.11	156.54	138.03
BHM1	L	Standard deviation		0.38	7.07	2.51	1.08	0.43
BHM3	R	Average	2	175.78	30.00	23.72	154.88	136.53
BHM3	R	Standard deviation		1.16	1.41	13.38	0.60	0.33
BHM3	L	Average	2	174.76	28.00	43.15	155.28	136.71
BHM3	L	Standard deviation		0.45	8.49	25.00	0.44	0.77
BHM4	R	Average	2	175.97	52.00	9.83	156.04	134.27
BHM4	R	Standard deviation		0.50	2.83	2.92	0.41	0.81
BHM4	L	Average	2	177.18	28.50	14.29	155.00	135.55
BHM4	L	Standard deviation		2.19	4.95	10.12	0.34	1.39

Appendix E.

List of manufacturers

Endevco
Rancho Viejo Road
San Juan Capistrano, CA 92675

Pacific Instruments
215 Mason Circle
Concord, CA 94520

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